



Executive
Perspectives

War in Ukraine: Initial view on Supply Chain Impact

BCG Global Advantage and Operations Practice Areas

Prepared: 10 March 2022

Introduction to this document

The war in Ukraine is above all a political and humanitarian crisis...

Russia's invasion of Ukraine has led to a serious **humanitarian crisis**. BCG condemns this attack and the violence that is killing, wounding, and displacing so many people.

The top priority in moments like these must be the **safety and security of people**. Corporates, governments, and non-for-profit organizations should focus on supporting the people in Ukraine, Russia, Europe, and globally affected (physically and mentally).

It is the duty of political, societal, and business leaders to navigate through this crisis. **The intent of this document is to inform discussions on the supply chain impact of the war in Ukraine.**

The situation surrounding Ukraine is dynamic and rapidly evolving - this document reflects information and analysis as of **10 March 2022**. It is not intended as a prediction of future events and is shared only as a resource for BCG and client conversations.

BCG Executive Perspectives

IN THIS DOCUMENT

SUPPLY CHAIN IMPACT

Russia and Ukraine account for only a small percentage of global trade. But the war will have an outsized impact on industrial supply chains that have already been disrupted by the pandemic. Soaring prices and shortages of steel, nickel, fertilizers, and wheat will hobble sectors as diverse as electric vehicles, canned beverages, semiconductors, and agribusiness. Plant closures have caused shortages of essential components, such as wire harnesses used in cars. High fuel prices and the disruption of Ukrainian and Russian cargo routes are raising logistical costs for all kinds of traded goods.

Companies are already acting to mitigate these rapidly evolving risks. But with the war and its geopolitical impact likely to be prolonged, supply-chain resilience must become a C-suite priority. Companies need to gain clearer visibility into risks throughout their value chains based on multiple scenarios, such as additional sanctions, enduring high energy costs, and potential cybersecurity attacks. They should consider building resilience by reconfiguring their global supply chains, revisiting their approach to stocking intermediate goods, and taking a more proactive approach to managing suppliers. For the longer term, companies need to develop the capabilities to better monitor and rapidly respond to disruption.

War in Ukraine: Supply Chain Impact

AGENDA

Deep-dive: First view on Supply Chain Impact

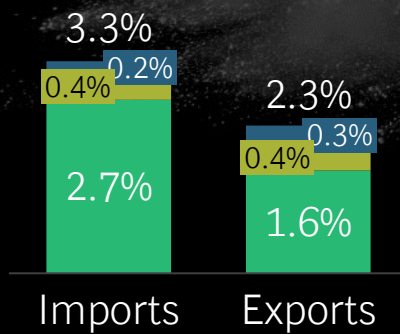
> Current situation and context

- > Supply and cost impacts
- > Supply chains at risk
- > Implications for leaders

Russia, Ukraine, and Belarus make up a small percentage of global trade but have an over indexed share of trade in Europe specifically

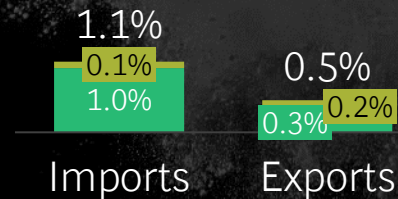
World

% of global trade



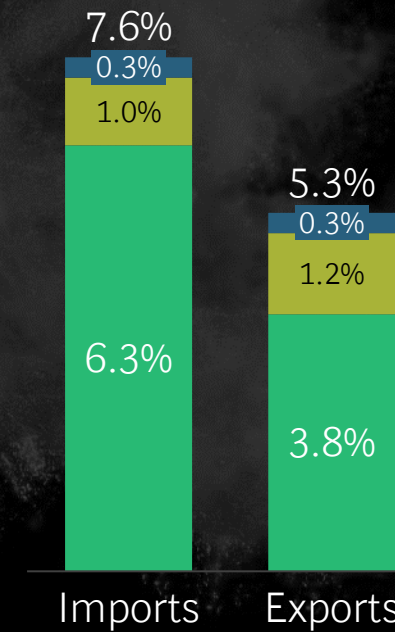
US

% of US trade US



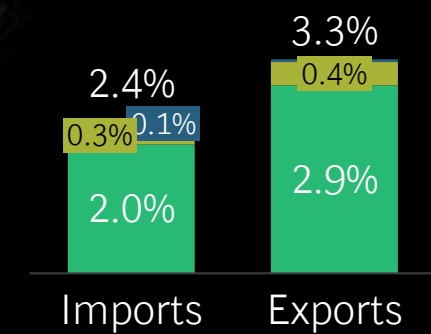
Europe

% of EU trade



China

% of China trade



■ Russia ■ Ukraine ■ Belarus

Overview: Several major sectors impacted, with many supply chains at risk

Before war in Ukraine, global supply chains were under stress from COVID and geo-political events (e.g., Brexit, tariffs, etc.)

Supply and cost impacts

Commodity shortages

Difficulty sourcing and/or higher prices for key commodities

Component/product sourcing challenges

Inability to source manufactured goods and inputs due to plant closure

Demand shocks

Slowdown in manufacturing / inability to import impacting exporters

Logistics

Rise of logistics costs due to capacity and fuel impact

Supply chains at risk

Supply Chains impact **varies across sectors**. A few examples emerge:

- **Steel:** Supply risks in Europe due to disruptions of intermediate and finished steel products (e.g., pig iron, slabs)
- **Semiconductors:** Short supply especially of advanced chips exacerbated – main impact auto, industrial, electronics
- **Automotive:** Disruption of raw materials and component inputs – accelerate inventory shortages and rising global prices
- **Agribusiness:** Shortages (e.g. wheat, fertilizer) and increased transport costs likely to drive up commodity and food-goods prices

Implications for leaders

Short-term: Understand risks & impact, prioritize customers to protect; find alternative sources, rebalance global network

Mid-to-long term: Build in resilience & anticipate areas of exposure, elevate supply chain risk to C-suite, optimize global footprint, dual source, re-set supply chain buffers

War in Ukraine: Supply Chain Impact

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Deep-dive: First view on Supply Chain Impact

- › Current situation and context

- › **Supply and cost impacts**

- › Supply chains at risk

- › Implications for leaders



Raw Materials | Steel, Auto, and Agribusiness most impacted due to current or potential unavailability of supply from Russia and Ukraine

Raw mat'ls with high Russia, Ukraine, Belarus share¹

Top export markets

Industries primarily impacted

Sanctions as of 10 March 2022⁴

| | | % of global exports | | | | | | | | | | |
|--|--|---------------------|----|-----|-----|-----|-----|--|--------------|--|------------|---|
| | Russia | | | | | | | | | | | |
| | Ukraine | | | | | | | | | | | |
| | Belarus | | | | | | | | | | | |
| | Pig iron (nonalloy) | 43 | 21 | 44% | 21% | 12% | 7% | | Steel | | | n/a |
| | Anthracite coal | 54 | 2 | 24% | 17% | 13% | 11% | | Energy | | Steel | Mar 8 ban import of Russian coal |
| | Semifinished product of iron or steel | 27 | 11 | 19% | 16% | 14% | 7% | | Steel | | | n/a |
| | Uranium; Plutonium ² | 35 | | 37% | 34% | 17% | 12% | | Energy | | | n/a |
| | Potassium chloride fertilizer | 17 | 17 | 39% | 23% | 8% | 7% | | Agribusiness | | | Jan 7 ban imports from Belarus |
| | Mineral or chemical fertilizers ³ | 25 | 3 | 29% | 19% | 12% | 10% | | Agribusiness | | | n/a |
| | Palladium | 26 | | 28% | 26% | 23% | 7% | | Automotive | | | n/a |
| | Cereals (wheat & meslin) | 14 | 10 | 26% | 13% | 6% | 5% | | Agribusiness | | | n/a |
| | Aluminum (non-alloy) | 21 | | 39% | 19% | 9% | 5% | | Construction | | Automotive | n/a |
| | Nickel ⁵ | 20 | | 49% | 36% | 4% | 3% | | Steel | | Battery | n/a |
| | Titanium ⁶ | 15 | 2 | 39% | 32% | 7% | 6% | | Aerospace | | | n/a |
| | Natural gas ⁷ | 16 | | 65% | 14% | 3% | 3% | | Energy | | | Mar 8 ban import of Russian liq. nat. gas |

Deep dive to follow

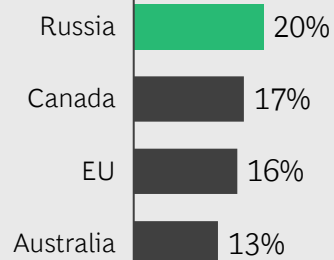
Note: Trade data from 2019; Based on HS6 level except for Nickel at HS4 level (7501,7502) Filtered for products w/export value >\$1B; Where no value for BY or UA; <1% of global exports 1. Analysis based on HS6 codes: 270111, 720110, 284420, 720711,711021, 310520, 750210, 760110, 310420, 271121, 100199; 2. And its compounds 3. Mineral or chemical fertilizers containing nitrogen, phosphorous, potassium; Russia indicated they might halt exports; 4. Excludes impact of indirect sanctions i.e., on financing, transport, and sanctions on individuals 5. Hs4 level data (7501,7502) 6.Titanium on HS4 level (8108), OEC data 7. In gaseous state Source: USGS, FAO, UN Comtrade, EIA, OEC World, BCG Analysis, Web search



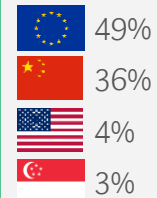
Nickel | Stainless steel and battery production impacted lack of access to supply from Russia

Top 5 exporters¹

% of global exports

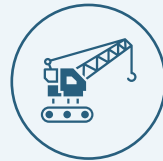


Russia's top customers



Industry impact

1st order



Stainless steel
(~70% of primary nickel)

- **4,100kt SST supply at risk** (75% of EU production)
- ~90kt of import needed, taking away from competitors

2nd order

- **Food & Bev industry** (820kt) with highest demand hit first; Chemical and Automotive also exposed
- **Increased competition** for secondary supply

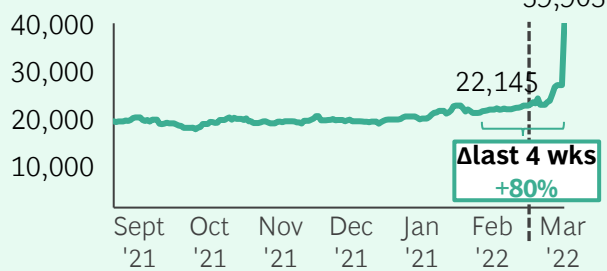


Battery
(~10% of primary nickel; ~40% by 2040)

- Lost supply, **difficult to replace** as demand increases
- **Changing supplies** decrease production efficiency short term
- **Potential shortages** for materials may delay EV³ industry growth
- **Poor ESG footprint** for substitutes from other regions (carbon-intensive)
- ≈ **Localized supply chains** down to mine-level in high demand

Pricing

Price (LME, \$/Ton) and % impact on past 4 weeks²



Mar 8: Trading halted as price reached 46,528 (>\$100k/t)

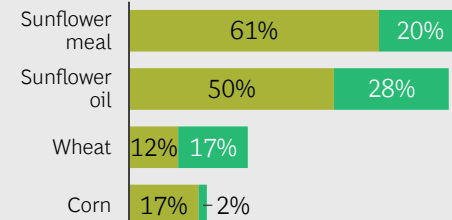
Note: export data for HS4 codes 7501, 7502; Pricing data as of Mar 7 2022 1. For Nickel HS4 codes (7501, 7502) 2. London Metal Exchange – in US\$ per metric ton, price increase based on 4 wks avg trading price 2. Electric Vehicles Source: Roskill; USGS; FAO; UN Comtrade; EIA; Nickel Association; Nickel Institute; Desk research; BCG analysis

Agribusiness | Disruption of Russian & Ukrainian supply of wheat, corn, and sunflower supply impacting grain and feed markets

Russia and Ukraine exports

% of global exports

Ukraine Russia



Top wheat customers



Industry impact

Corn and sunflower seeds not yet sown, **unclear if seeded wheat can be nurtured and harvested in Ukraine** — usual fertilizer applications at this time of season have mostly failed

Likelihood of **missed growing season** in Ukraine due to ongoing conflict, exodus of refugees

Sanctions not in place, but **Russian export ban possible and Black Sea exports impacted**

1st order



Food

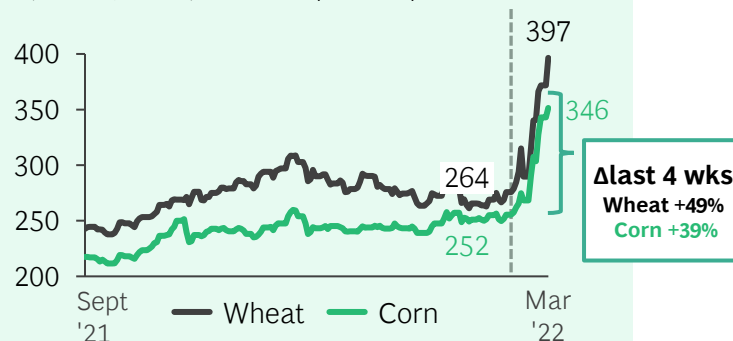
- Wheat, sunflower, corn shortages & higher prices
- Pressure on reliant companies to find other supplies
- Higher prices for foods globally (e.g., bread, with prices in Egypt rising 50% in 2 days after invasion)
- Soy and meat prices to rise, as sunflower meal production (animal feed) in Ukraine is disrupted

2nd order

- Protectionist food policies, with Hungary, Turkey and Argentina already increasing export control²
- Risk of social unrest, in low food security nations (e.g., Lebanon)
- Undernutrition, in Global South³ (e.g., Sub-Saharan Africa)
- Substitutional goods will see increased production (2023)

Pricing

Price (MATIF, €/bu.) and % impact on past 4 weeks¹



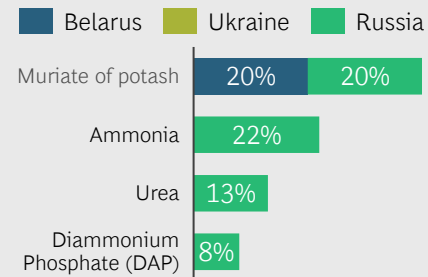
Note: Pricing data as of Mar 7 2022 1. S&P Capital IQ (EUR per MT); 2. As reported by Bloomberg ([here](#)) 3. Southern Hemisphere
Source: Bloomberg, New York Times, Barclays Equity Research, ING Economic and Financial Analysis, Financial Times, Middle Eastern Eye, BCG analysis



Fertilizer | Crop yields at risk due to potential shortage of Russian & Ukrainian fertilizer

Exports

% of global exports



Top customers



Industry impact

Russian Trade Ministry **urged halting fertilizer exports** as of Mar. 04 2022

Prices have already increased (v. Oct '21): Ammonia (+90%), Urea (+20%), DAP (+15%), & MOP³ (+75%)

Russian owned companies are key players in fertilizer market, so possibility for further industry disruptions in other fertilizer components (e.g., nitrates, phosphates, potassium compounds)

1st order



Agribusiness

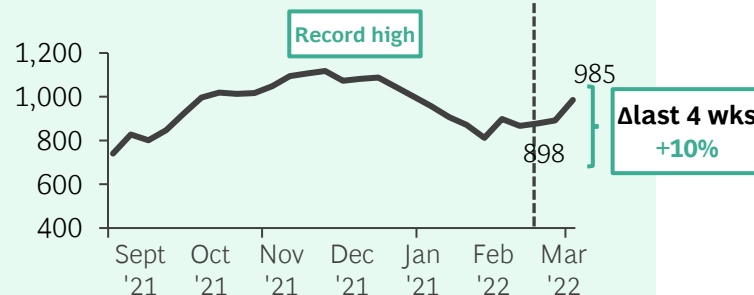
- Reduced global fertilizer supply leading to higher prices
- Pressure on companies reliant on Russian & Belarussian fertilizers to promptly find alternative supplies; however, few substitutes exist
- Weakened Crop Yields in 2022-23 from under-fertilization and sowing fewer seeds

2nd order

- Prices of soaps, animal feeds & household cleaners will rise, as N/P/K⁴ are also part of cost base
- Fertilizer trade-flow rebalancing: compounds flow to "friendly" countries to Russia
- MENA⁵, Americas, & Canada to explore or expand local options and alternative sources of Nitrogen & Phosphorous (used in fertilizer)

Bloomberg Fertilizer Price Index²

Price (USD) and % impact on past 4 weeks

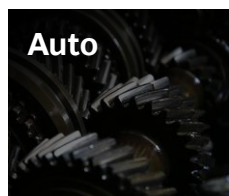


1. Eurasian Economic Union – Armenia, Belarus, Kazakhstan, Kyrgyzstan, Russia 2. Bloomberg Green Markets Fertilizer index 3. Muriate of Potash 4. Nitrogen, Phosphorous, Potassium 5. Middle East and North Africa Source: Bloomberg, New York Times, Barclays Equity Research, ING Economic and Financial Analysis, Financial Times, Middle Eastern Eye, BCG analysis



Component sourcing & demand shocks | Supply and demand ripple effects created by companies stopping or limiting Russian & Ukrainian operations

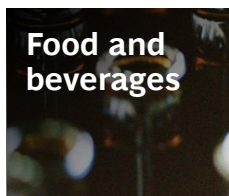
Companies across industries stopping or limiting operations for component shortages or to protect personnel...



Auto

 **Foreign OEMs (e.g., Hyundai¹, VW², Ford³)** halting car production, import/ export and servicing in Russian operations

 **Leoni AG⁴, Kromberg & Schubert⁵** and other global tier 1 & 2 suppliers closed Ukrainian plants (manufacturing in wire harnesses)




Food and beverages


 **Consumer goods companies (e.g., Heineken⁶, Carlsberg⁷, Unilever⁸, Pernod Ricard⁹)** suspended exports to Russia and/or Russian production

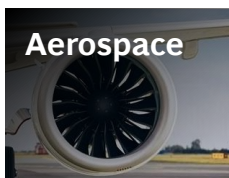
 **Consumer goods companies (e.g., AB InBeV¹⁰, Coca-Cola¹¹)** shutdown beverage production in Ukraine



Chemicals/ Pharma

 **BASF¹²** halted investment in new business and operations in Russia, except for production related to humanitarian efforts

 **Biosphere¹³** cut production of personal care products & biodegradable plastics in Ukraine



Aerospace

 **Airbus¹⁴** suspended support services & supply of spare parts to Russian airlines; **Boeing¹⁵** stopped procuring titanium from Russia

 **Boeing¹⁵** temporarily closed Kyiv office employing ~1000 engineers

...with two main effects for global supply chains

1 **Negative demand shock** on manufacturing inputs exported to Russia/Ukraine. Will cause **lost sales** for some suppliers and create sourcing opportunities for manufacturers outside of Russia/Ukraine

2 **Lack of supply** of key components and products for companies importing from Russia/Ukraine, impacting those importers' ability to satisfy their customers' demand

1. [KBS World \(03/09\)](#) 2. [WSJ \(03/03\)](#) 3. [Reuters \(03/01\)](#) 4. [WSJ \(02/27\)](#) 5. [Reuters \(03/03\)](#) 6. [NL Times \(03/05\)](#) 7. [Reuters \(03/04\)](#) 8. [Reuters \(03/08\)](#) 9. [The Times \(03/07\)](#) 10. [Fortune](#) 11. [Reuters \(02/24\)](#) 12. [Nasdaq \(03/03\)](#) "Effective immediately, BASF will only conduct business in Russia and Belarus that fulfils existing obligations in accordance with applicable laws, regulations and international rules.", 13. [Forbes \(03/06\)](#) 14. [BBC \(03/02\)](#) 15. [Reuters \(03/07\)](#) Source: Press, web search, company announcements, BCG Analysis



Logistics | Global freight routes further distressed leading to reduced capacity and increased costs across industries



AIR FREIGHT: Rates approaching record highs (120% above pre-COVID)¹

Flight bans and sanctions to cause **capacity loss** in EU-Asia lane (21% of cargo) exacerbating capacity crunch. Portion will cancel vs re-route

Super-connector airlines in the **Middle East** may serve as a substitute¹

Jet fuel prices up 27% month over month¹, likely to drive cargo rates up further



SEA FREIGHT: Moderate impact on capacity, significant risk from fuel

Congestion expected at northern EU ports to process 200 rerouted ships waiting to cross the Kerch Strait²

Maersk, ONE, MSC, Hapag-Lloyd have suspended shipments to Russia & Ukraine²

Bunker (marine fuel) up 84% vs. last year³, bunker is ~45% of vessel op costs; however, rates currently detached from container rates



ROAD & RAIL: China-EU railroad stopped & EU truck drivers shortages heightened

Disrupted China-EU railway - linking 24 countries & 264 cities, and intended alternative to global sea and air freight⁴

Rail lines through Russia closed: Asian exporters need to find new routes to EU⁵

Ukrainian truck drivers returning to the Ukraine exacerbating EU driver shortage (e.g., 30%+ drivers in Poland from Ukraine⁶)

Over-the-road trucking costs rising from fuel

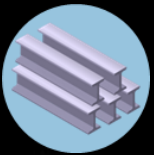
1. IATA: Europe-Asia, Asia-North America most heavily hit by airspace closure, Based on CTKs (cargo ton kilometers) over the past 12 months; 2. Business Insider: Russia's War on Ukraine Could Triple Ocean Shipping Rates Say Experts, 3. Freightwaves: Ship fuel spikes to historic \$1,000/ton mark as war fallout worsens, 4 South China Morning Post: China-Europe rail trade set for infrastructure upgrade, with container traffic up 30 per cent, 5. CSCMP's Supply Chain Quarterly: Logistics pros warn of business impact from Russia-Ukraine war, 6. Fortune: Russia invasion: Ukrainian emigrants leaving safety and heading to war Source: Web search; BCG analysis

War in Ukraine: Supply Chain Impact

AGENDA

Deep-dive: First view on Supply Chain Impact

- Current situation and context
- Supply and cost impacts
- **Supply chains at risk**
- Implications for leaders

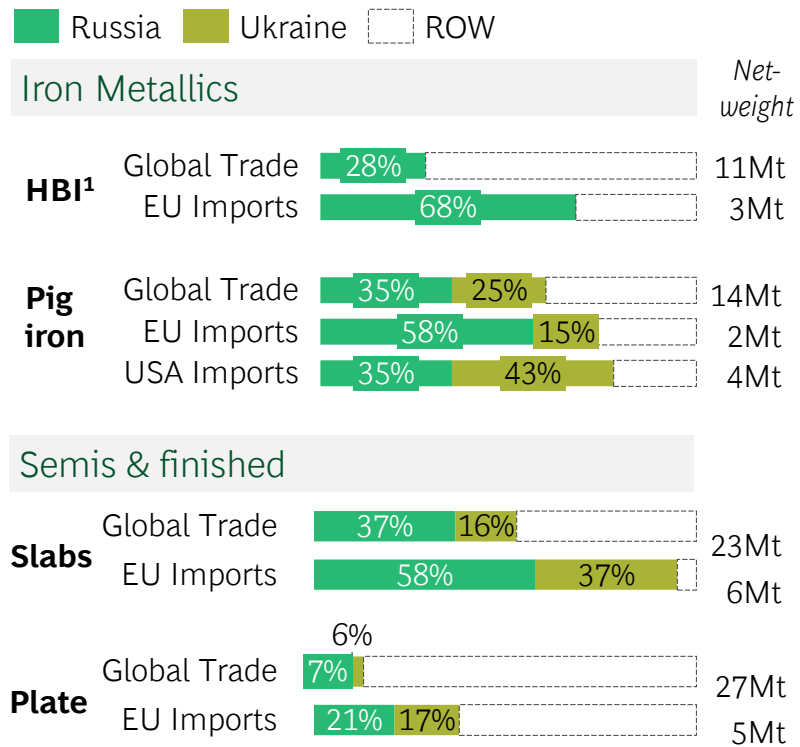


Steel | Supply risks – especially among European re-rollers – due to disruption of intermediate and finished steel products

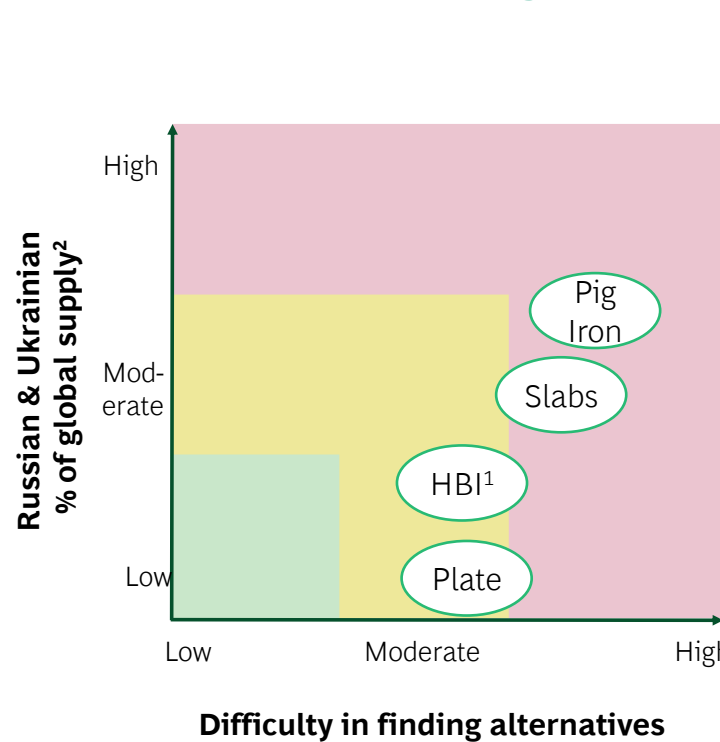
Risk Summary

| | | | |
|-----------------------|----------------------|---------------|--------------------------|
| Access to commodities | Cost for commodities | Demand Shocks | Access to mfg components |
| | | | |

Russia & Ukraine supply much of world's intermediate / finished steel products



Producers & industrial goods sector in Europe / US likely impacted



Russia is lowest cost producer globally - **likely to divert its exports to Asia**

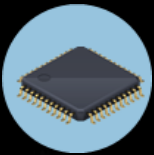
EU re-rollers will be particularly impacted by supply shortage due to slab reliance

US producers using Electric Arc Furnaces impacted by shortage of metallics (HBI¹, pig iron) used in high-quality production

Wind turbine towers and pipe/tube for oil & gas are examples with cost & lead time impact

Already **record high steel prices** (scrap, met coal, power) and could further rise due to crisis

1. Hot Briquetted Iron, has production benefits when used in Electric Arc Furnace (EAF) 2. Estimated using extra-regional trade as a proxy
 Note: Trade data from 2020; Based on HS6 level Source: UN Comtrade, BCG Analysis, Web search

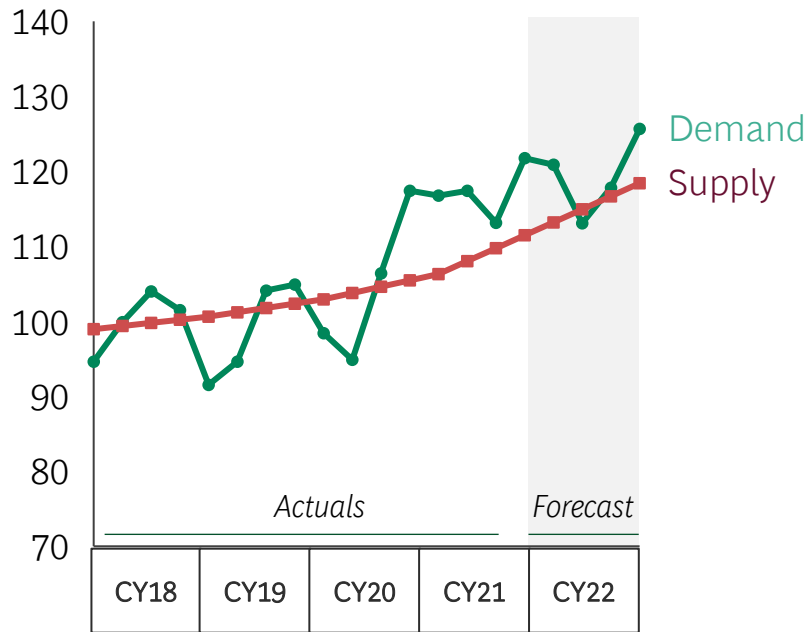


Semiconductors | Already short global supply further exacerbated by raw material shortages will continue to impact auto and consumer electronics

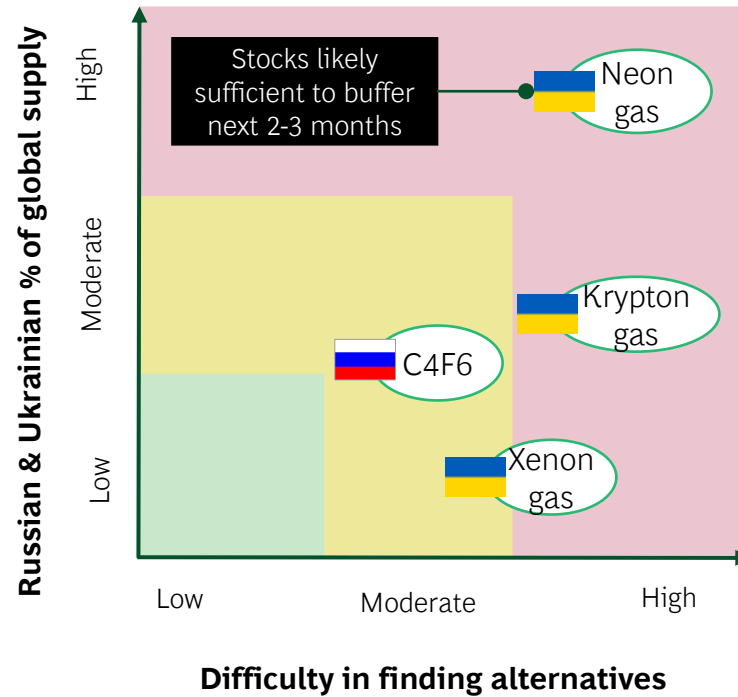
| Risk Summary | | | |
|------------------------------------|------------------------------------|---------------|--------------------------|
| Access to commodities | Cost for commodities | Demand Shocks | Access to mfg components |
| ● | ● | N/A | N/A |

Large demand-supply imbalance already before the Ukraine crisis

Demand¹ and supply² for semiconductors (pre-Ukraine crisis view³); Index base = Quarterly 2018 average



Once existing stocks of required gases are depleted, a continued shortage of semiconductors expected until alternate suppliers found



Gases are **critical consumable for semiconductor production** – e.g., Neon required for manufacturing of advanced chips

If crisis continues, lower gas availability (especially Neon) could **further deepen chip shortage** and thereby reduce availability

Sectors using advanced chips (e.g., **cell phones, computers, etc.**) impacted most

Auto, industrial and other sectors also impacted, as shortage on gases reduce semiconductor production yields

Situation likely transient, as new gas production scheduled to be available over next 6-12 months (in Germany, Singapore, Japan)

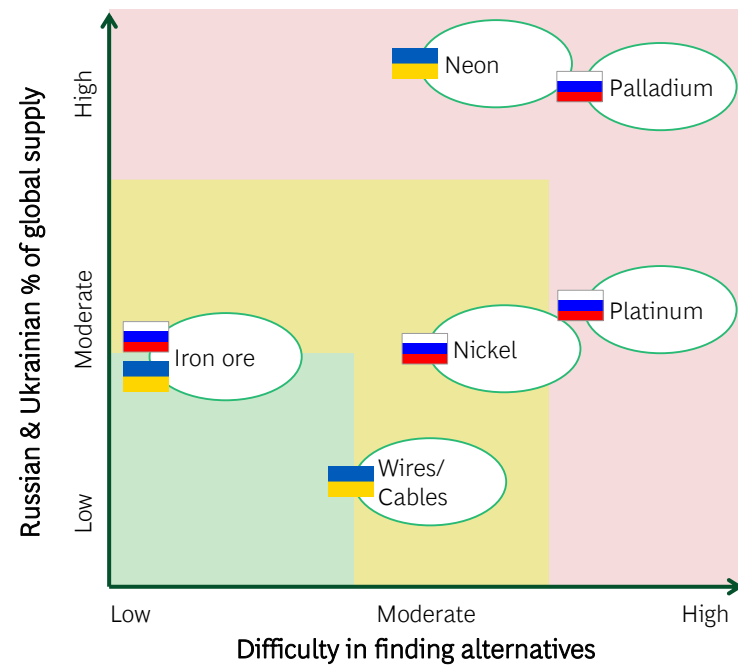
1. Historical and projected sales; forecasts derived from projected demand evolution of selected end-industries. 2. Historical and projected production; 3. BCG IC Model Forecast
 Note: Drop in semiconductor demand due to sanctions will not provide a meaningful demand reduction, as Russia represent a small share of global semiconductor demand
 Source: BCG IC Model Forecast, BCG analysis, Factiva, Expert inputs



Auto | Challenges in sourcing multiple impacted components in near-term, creating risk of exacerbating existing supply shortfalls



Risks to key inputs with limited alternatives already impacting vehicle manufacturing ...



Selected examples



Effect



... with other challenges that have potential to reduce output

- Rising palladium & platinum prices:** limit OEM production of ICE cars (due to catalytic converter application) meeting ESG regulations, potential to stimulate EV adoption
- Transient impact from neon disruption:** Microchip manufacturers securing new supplies; gas producers installing new plants
- Shortages of wires/cables likely transient:** Companies rerouting production/supply from tier 1 & 2 suppliers in Ukraine
- Nickel shortages will **increase cost of EV batteries** in the short-term, but impact unlikely to be long-term as newly developed Nickel-free batteries will help mitigate the shortage risk

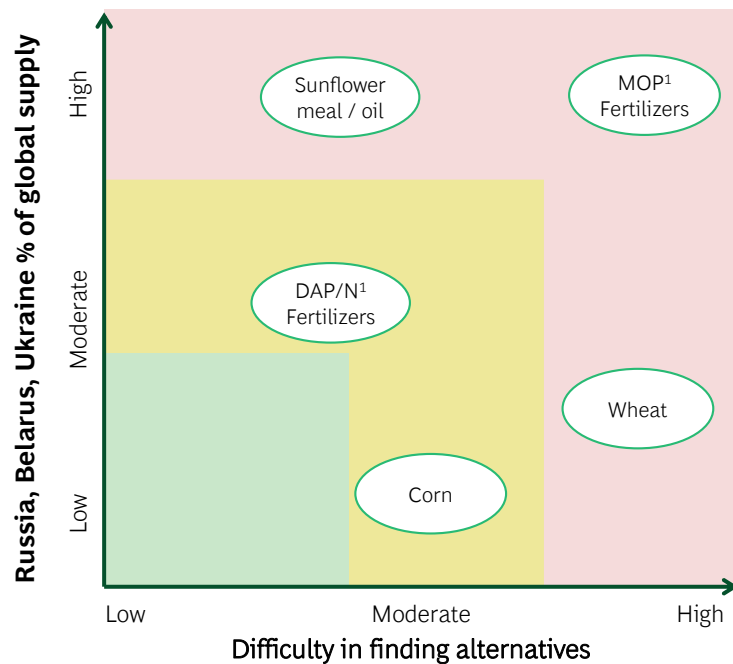
Note: Ukraine also producer of other auto parts such as seat covers, injections molding parts, but contribution to global production negligible. CIS : Commonwealth of Independent States; % of global supply in MT for raw materials and in M\$ for Wires/cables; Low: < 5%, Moderate: 5-10%, High: >25%, Moderate 1. WSJ (02/27) 2. Barrons 3. IHS Markit
 Source: S&P Capital IQ, ITC TradeMap, HIS Markit, Automotive News, EPS News, BCG analysis



Agribusiness | Constrained supply of fertilizer will impact crop productions and increase prices for a variety of food goods



Supply constraints will lead to higher industry costs and shortages



Crop production will decrease through '23 from Ukraine supply loss & fertilizer supply constraints

Higher animal product prices through '23 due to higher feed cost

Most **food goods to see higher prices as supply tightens** adding to already high food inflation

Unclear impact on agriculture inputs (machinery and equipment)

Food insecurity to increase especially in Global South, Middle East, & North Africa

Will exacerbate existing supply issues incl. the South American drought & shipping congestion

Price rise of wider commodities due to second-order impact

Price Mar 9, 2022 vs EOY 2021²

- Soybeans +27%** Primarily animal feed that substitutes for sunflower meal
- Milk +22%** Animal products already impacted by higher feed cost
- Palm Oil +48%** Cooking/frying oil impacted by reduced sunflower oil supply
- Rice +6%** Grain impacted by high fertilizer cost & reduced grain supply

1. MOP = Muriate of Potassium, DAP = Diammonium Phosphate, N = Nitrogen 2. Business Insider Commodities Tracker; end of day March 9, 2022
 Source: Bloomberg, New York Times, Barclays Equity Research, ING Economic and Financial Analysis, Financial Times, Middle Eastern Eye, BCG analysis

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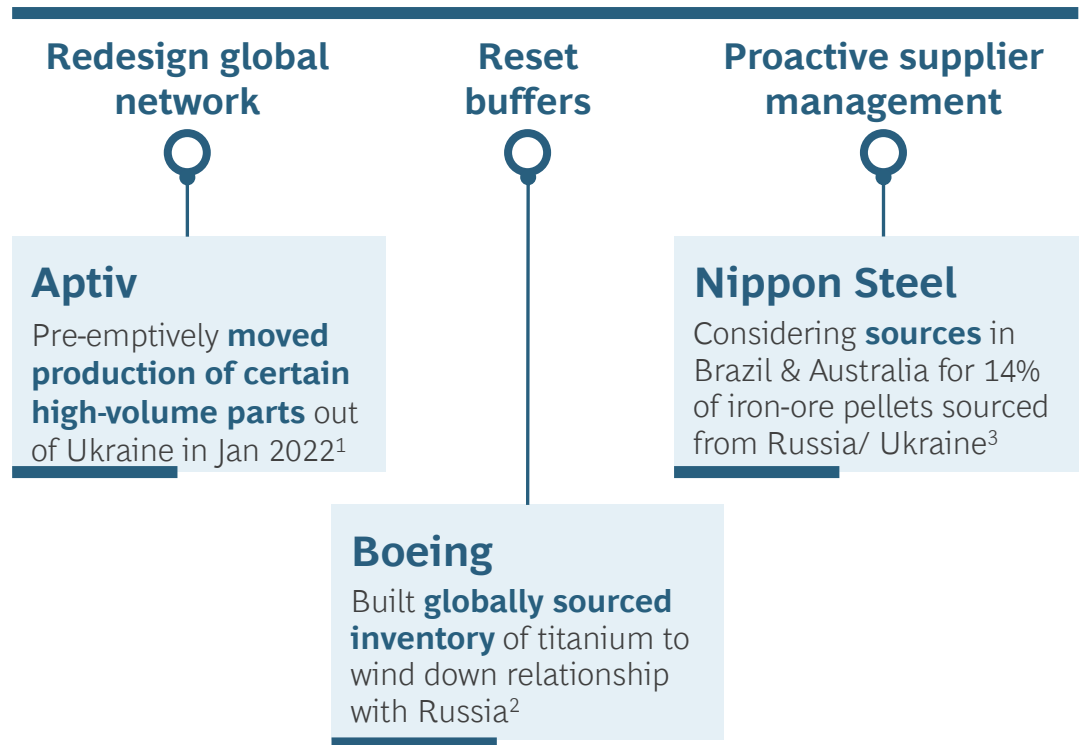
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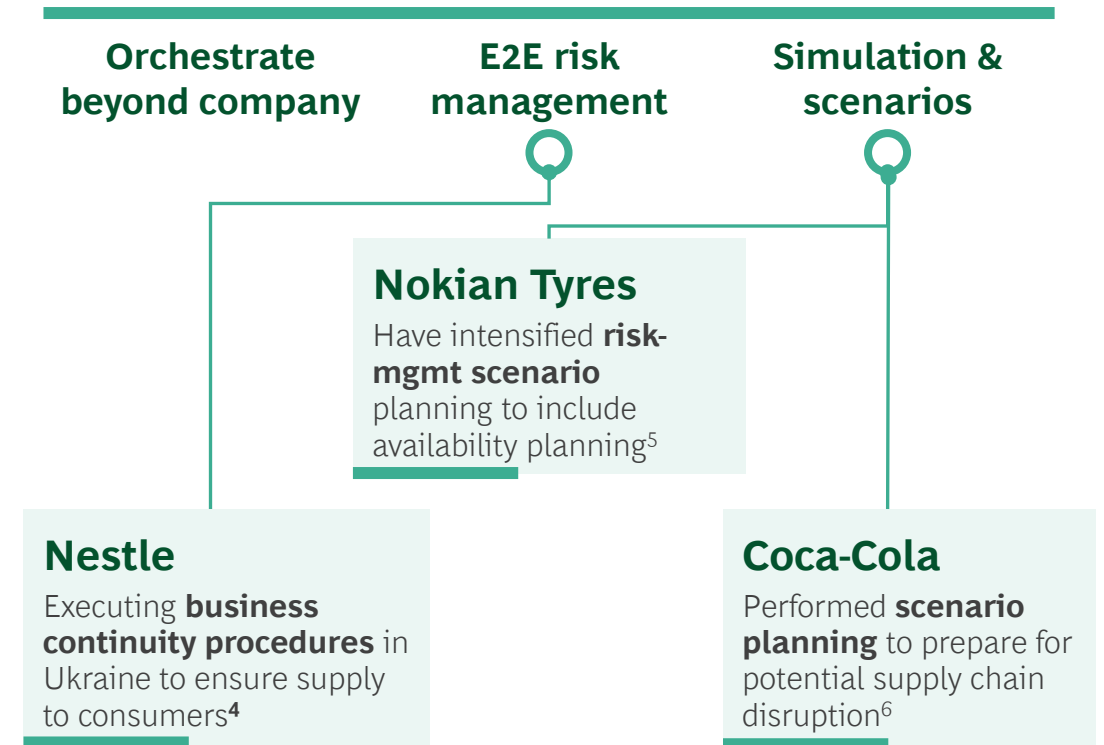
Companies taking immediate, short-term actions to mitigate rapidly evolving supply chain risks...

How companies are responding today

RECONFIGURE SUPPLY CHAIN



RESPOND RAPIDLY TO DISRUPTION

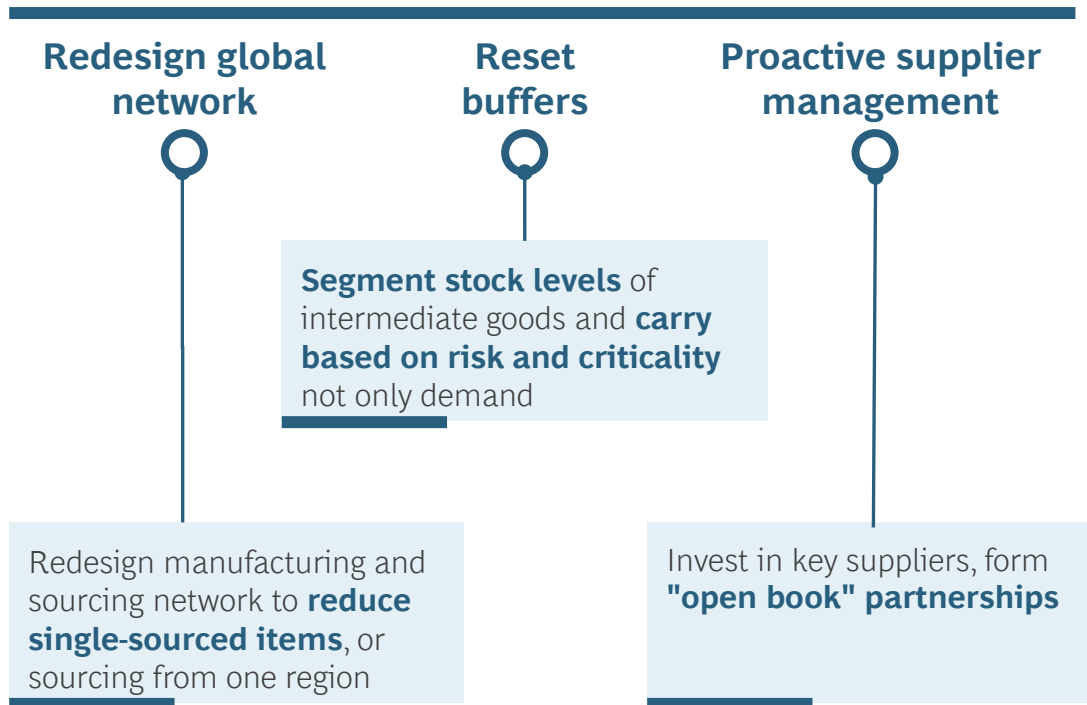


1. Reuters: Auto parts maker Aptiv recently shifted high-volume Ukraine-CEO 2. Simple Flying: Boeing Isn't Worried About A Lack Of Russian Titanium 3. Mining Technology: Russia-Ukraine crisis hits ArcelorMittal and Nippon Steel 4. Reuters: Nestle says operations running normally in Ukraine, continuity plans in place 5. Reuters: Nokian Tyres moves some production and stock out of Russia 6. Reuters: London-listed Coca-Cola HBC readies Russia contingencies as profits rise Source: Web search; BCG analysis

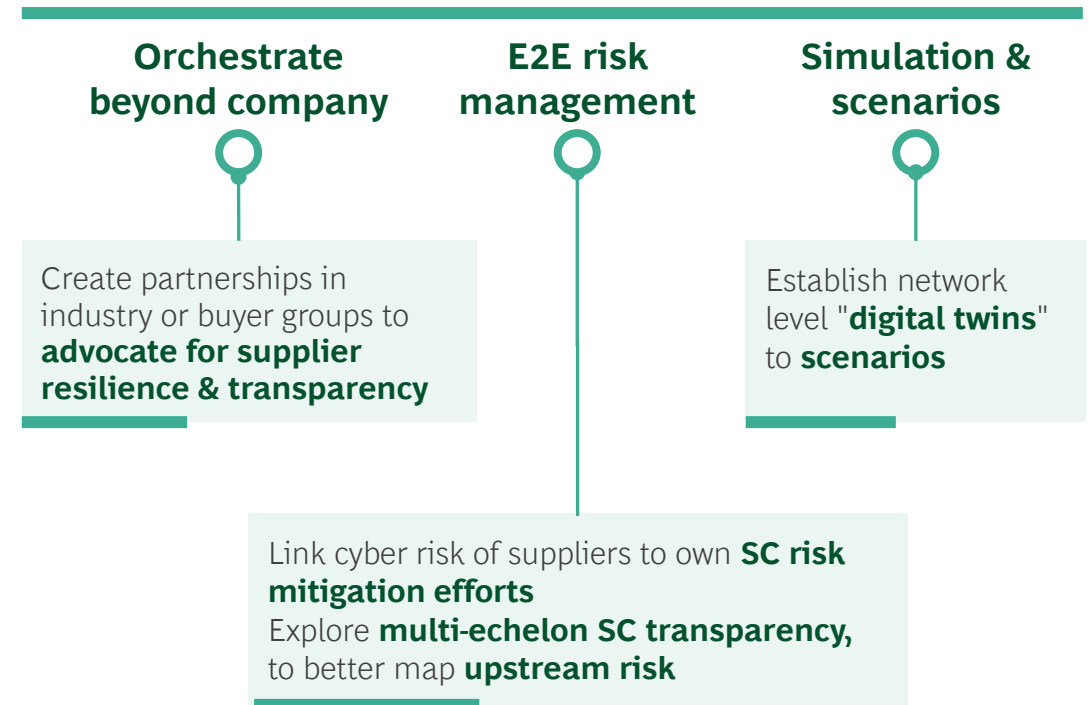
... and should build capabilities over the medium and long-term to build resilience for future disruptions

How companies can build supply chain resilience in the medium to long term

RECONFIGURE SUPPLY CHAIN



RESPOND RAPIDLY TO DISRUPTION



This is a rapidly evolving situation, and other emerging global risks will change how companies – and their supply chains – need to respond

Thus far, markets & companies have responded mainly to the immediate and direct results of the war

The impact of the war on commodities, companies, and industries will evolve over time, and may have **more complex second order effects** that leaders will need to navigate

Some examples of these potential effects which can complicate the picture include:

- Risk of **recession** and resulting softening of demand
- Longer **duration** or wider spread of conflict
- Escalation of **sanctions** and/or export bans
- Enduring elevated **energy costs** – as a cost input

As the conditions change, the risks to supply chains and required responses from companies to mitigate those risks will also continue to evolve

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