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).

… but it is driving disruption across global supply chains

It is the duty of political, societal, and business leaders to navigate through this crisis. The intent of this document is to inform discussions and decisions on the global economic impact as well as the supply chain and procurement 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.
**Summary snapshot | Largest refugee crisis in Europe since 1945**

**2.8+ Million Refugees on the move**

*Ukrainian Refugees by Destination Country (M)*

- **Poland**: 1.7
- **Ukraine**: 0.3
- **Slovakia**: 0.2
- **Hungary**: 0.3
- **Russia**: 0.1
- **Belarus**: 0.001
- **Moldova**: 0.08
- **Romania**: 0.001
- **Other European countries**: 2.8

**Significant impact across Europe and beyond**

- All 27 EU countries offering 'temporary protection' to UA nationals, including healthcare, accommodation and temporary work permits
- Polish Government estimating refugee support costs could reach $1.7B
- Huge medium-term challenge for Europe to absorb, house, educate, skill and employ numbers on such a scale
- EU providing financial support to non-members to aid with refugee costs (e.g., Moldova)
- Countries further afield (e.g., Canada) offering fast-track entry terms to Ukrainians

Source: Data from UN High Commissioner for Refugees (UNHCR) as of 13 March, updated daily at: https://data2.unhcr.org/en/situations/ukraine

Prepared: 13 March 2022 – Confidential: Limited Distribution
# War in Ukraine: Global Economic Impact

## Global Growth Outlook

<table>
<thead>
<tr>
<th>GDP Forecasts1</th>
<th>Leading FIs 2022 (Jan ‘22 Forecast)</th>
<th>World Bank 2022</th>
<th>Leading FIs 2022 March ’22 Forecast</th>
<th>Leading FIs 2022 March ’22 Median</th>
<th>Leading FIs 2022 March ’22 Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russia 2021 Actual</td>
<td>4.7%</td>
<td>2.4%</td>
<td>-4.4%</td>
<td>-10.4%</td>
<td></td>
</tr>
<tr>
<td>Euro Zone 2021 Actual</td>
<td>5.3%</td>
<td>4.2%</td>
<td>3.3%</td>
<td>2.2%</td>
<td></td>
</tr>
<tr>
<td>Global 2021 Actual</td>
<td>3.9%</td>
<td>4.1%</td>
<td>4.5%</td>
<td>3.4%</td>
<td></td>
</tr>
</tbody>
</table>

## Supply Chain Metrics

### Deep Sea Cargo Bosporus Straits Transits (Avg. #/day)2

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Northbound</td>
<td>8.9</td>
<td>4.4</td>
<td>5.1</td>
</tr>
<tr>
<td>Southbound</td>
<td>9.6</td>
<td>9.7</td>
<td>5.9</td>
</tr>
</tbody>
</table>

### Deep Sea Cargo Port Calls (Avg. #/day)2

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ukraine</td>
<td>4.5</td>
<td>0.6</td>
<td>0.1</td>
</tr>
<tr>
<td>Russia</td>
<td>21.7</td>
<td>22.7</td>
<td>19.3</td>
</tr>
</tbody>
</table>

### Baltic Dry Index (Daily Avg)3

<table>
<thead>
<tr>
<th>Pre-War (Nov ’21)</th>
<th>Prev. Wk (2/24-3/1)</th>
<th>Curr. Wk (3/3-9)</th>
<th>ΔCW-PW</th>
</tr>
</thead>
<tbody>
<tr>
<td>BDI</td>
<td>2780</td>
<td>2101</td>
<td>2229</td>
</tr>
</tbody>
</table>

## Commodity Prices4

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Commodity price (actual, $)</th>
<th>Jan ’22</th>
<th>Mar ’22</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude Oil ($/bbl)</td>
<td>79.0</td>
<td>123.2</td>
<td>+56%</td>
<td></td>
</tr>
<tr>
<td>Gas ($/MWh)</td>
<td>80.4</td>
<td>227.2</td>
<td>+183%</td>
<td></td>
</tr>
<tr>
<td>Coal ($/t)</td>
<td>157.5</td>
<td>422.7</td>
<td>+168%</td>
<td></td>
</tr>
<tr>
<td>Wheat ($/bu)</td>
<td>240.0</td>
<td>366.5</td>
<td>+56%</td>
<td></td>
</tr>
<tr>
<td>Rapeseed ($/t)</td>
<td>728.5</td>
<td>845.0</td>
<td>+16%</td>
<td></td>
</tr>
<tr>
<td>Nickel ($/t)</td>
<td>20,430.0</td>
<td>39,905.0</td>
<td>+95%</td>
<td></td>
</tr>
<tr>
<td>Palladium ($/oz)</td>
<td>1,826.0</td>
<td>2,899.9</td>
<td>+59%</td>
<td></td>
</tr>
</tbody>
</table>

## Sanctions & Policy Actions

- US bans Russian O&G imports, immediately
- EU to reduce Russia gas imports by 2/3 by end 2022
- UK to eliminate Russia oil product imports by end 2022
- Russia to restrict certain exports of Critical Materials
- Russia to seize assets of certain firms exiting Russia

## Corporate Actions in Russia Market

- Exit
- Suspend operations
- Halt shipments & supply
- Curtail access to capital
- Suspend new investment or partnership

### Based on sample of ~300 companies6

<table>
<thead>
<tr>
<th>Exit</th>
<th>Suspend operations</th>
<th>Halt shipments &amp; supply</th>
<th>Curtail access to capital</th>
<th>Suspend new investment or partnership</th>
</tr>
</thead>
<tbody>
<tr>
<td>33</td>
<td>109</td>
<td>88</td>
<td>22</td>
<td>52</td>
</tr>
</tbody>
</table>

1. GDP forecasts from World Bank and FIs per Bloomberg database (7-21 FIs per forecast period). 2. Deep Sea Cargo: oil tankers MR & up, bulk carriers Panamax & up, container ships 3,000-50,000 TEU, VLCCs, LNG carriers 60,000+ cbm & PCTCs 6,000+ cu. 3. © Clarksons Research Services Limited (“Clarksons Research”). All rights in and to Clarksons Research services, information and data (“Information”) are reserved to and owned by Clarksons Research. Clarksons Research is an independent group of companies and licensors and is not responsible for any errors or omissions in any Information or for any loss or damage resulting from the use of any Information. All rights reserved. We make no warranties for the Information contained in this communication. Please also see the disclaimer at https://www.clarksons.net/Portal/disclaimer, which also applies. No further distribution of any Information is permitted without Clarksons Research’s prior written consent. Clarksons Research does not promote, sponsor or endorse the content of this communication. 4. S&P Capital IQ®. 5. Total sanctioned actions, incl. duplication. Source: corrective.org 6. Yale Chief Exec Leadership Inst.
Key Sanctions & Policy Actions currently in-place

Current Sanctions & Policy Actions (Key examples)

**"Western" Allies**
- Co-ordinated policy/sanctions programs
  - Vs. Russian entities and individuals
  - Limiting Russia's access to Financial System
    - E.g., denial of access to SWIFT
  - Technology Export Controls
- US/UK/EU: Limiting purchases of Russian energy exports
- EU/Canada/US: Close airspace to Russian aircraft
- Canada: Drop Russia from WTO "Most Favored Nation" status

**Russia**
- Plan to limit exports of critical materials to certain countries (Details pending)
- Declared intent to seize assets of firms exiting Russia

**Large EMs**
- So far, no sanctions imposed by this group of countries
- Have asked for hostilities to cease
- China and India abstain at UN Security Council vote
- China official statements focus on peacemaking and mediation
- Indonesia in difficult position, as 2022 G20 host

Source: Gov. websites; Media reports; BCG analysis

### Current Sanction Actions by country and target

<table>
<thead>
<tr>
<th>Sanction Actions¹ in-place</th>
<th>EU</th>
<th>US</th>
<th>Canada</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>529</td>
<td>233</td>
<td>29</td>
<td>0</td>
</tr>
</tbody>
</table>

### Sanction Targets¹ / Δ since last week

<table>
<thead>
<tr>
<th>Individuals</th>
<th>Companies</th>
<th>Other entities</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ 115</td>
<td>+ 11</td>
<td>+ 59</td>
</tr>
</tbody>
</table>

1. Total sanctioned actions, includes some duplication
Source: www.correctiv.org
## Corporate Actions

### Company Announcements re: Russia Market per Yale School of Management tracking (as of 9 March 2022)

<table>
<thead>
<tr>
<th>Companies</th>
<th>Exit</th>
<th>Suspend Operations</th>
<th>Halt shipments/supply</th>
<th>Curtail access to capital</th>
<th>Suspend new investment or partnership</th>
</tr>
</thead>
<tbody>
<tr>
<td>BP</td>
<td>33</td>
<td>109</td>
<td>88</td>
<td>22</td>
<td>52</td>
</tr>
<tr>
<td>Bombardier</td>
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<tr>
<td>Rolls Royce</td>
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<td>JP Morgan</td>
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<td>Yum Brands</td>
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<td>Eni</td>
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<tr>
<td>Apple</td>
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<tr>
<td>Maersk</td>
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<tr>
<td>Black Rock</td>
<td></td>
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<tr>
<td>Kraft Heinz</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Goldman Sachs</td>
<td></td>
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<td></td>
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<tr>
<td>PepsiCo</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Boeing &amp; Airbus</td>
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</tr>
<tr>
<td>Credit Suisse</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Nestle</td>
<td></td>
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</tr>
</tbody>
</table>

**Definitions:**
- **Exit (Cease operations, divestment, discontinue, leave and withdraw business from Russia).**
- **Suspend Operations (Suspend activities, JV, sale points, manufacture in Russia).**
- **Halt Shipments/Supply (Temporarily stop / freeze sales and transportation of goods/services in, from Russia).**
- **Curtail access to capital (Financial Institutions (FI) restrict, reduce, cut, suspend, Russian access to capital provided by financial institutions).**
- **Suspend New Investments or Partnerships (Stop any new investments in Russia and suspend current sponsorships for Russian Athletes).**

As of March 10th, ~300 companies have announced a complete or partial withdrawal from Russia, based on news & press search.
Source: Yale School of Management; Press search; BCG analysis.
Key immediate impacts of the war on companies

Supply chain disruption
Russia and Ukraine are key exporters for agriculture, metals, energy
EU more exposed than US, and has more leverage in trade sanctions
Crisis creates key choke points across supply chain

Commodity price volatility
Clear price spike in gas and agricultural commodities
Crisis exacerbates already high energy prices and volatility

Sanctions & Doing Business risks
US, UK, EU, Canada take strong stance
Large Emerging Markets take more nuanced approach
Sanctions will also have 2nd/3rd order impacts
Financial Services is the most affected sector
Russia is also applying counter measures (e.g., restriction on liquidations)

Sales & Service risk
Sales in Russia will be challenging or even prohibited by Western Sanctions
Global consumer brands will be affected by sales, service and reputational risk in Russia
Import streams for industrial goods will be impacted

1. Energy (e.g., Oil & Gas) implications will be covered in a separate paper next week.
Note: BCG does not provide legal advice; Source: BCG experience and analysis.
Russia, Ukraine and Belarus make up a small percentage of global trade but have an over indexed share of trade in Europe specifically.
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 (p.10-12)

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 (p.13-16)

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 (p.17-18)

**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

Source: BCG experience and analyses
## Raw Materials

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

### Raw materials with high Russia, Ukraine, Belarus share

<table>
<thead>
<tr>
<th>Raw mater'ls with high Russia, Ukraine, Belarus share</th>
<th>% of global exports</th>
<th>Top export markets</th>
<th>Industries primarily impacted</th>
<th>Sanctions as of 10 March 2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russia</td>
<td>43</td>
<td>44%</td>
<td>Steel</td>
<td>n/a</td>
</tr>
<tr>
<td>Ukraine</td>
<td>21</td>
<td>21%</td>
<td>Energy</td>
<td>n/a</td>
</tr>
<tr>
<td>Belarus</td>
<td></td>
<td>12%</td>
<td>Steel</td>
<td>Mar 8 ban import of Russian coal</td>
</tr>
<tr>
<td>Pig iron (nonalloy)</td>
<td></td>
<td>7%</td>
<td>Steel</td>
<td></td>
</tr>
<tr>
<td>Anthracite coal</td>
<td></td>
<td>11%</td>
<td>Energy</td>
<td></td>
</tr>
<tr>
<td>Semifinished product of iron or steel</td>
<td>27</td>
<td>19%</td>
<td>Steel</td>
<td>Mar 8 n/a</td>
</tr>
<tr>
<td>Uranium; Plutonium</td>
<td>35</td>
<td>19%</td>
<td>Energy</td>
<td>n/a</td>
</tr>
<tr>
<td>Potassium chloride fertilizer</td>
<td>17</td>
<td>19%</td>
<td>Agribusiness</td>
<td>n/a</td>
</tr>
<tr>
<td>Mineral or chemical fertilizers</td>
<td>25</td>
<td>19%</td>
<td>Agribusiness</td>
<td>Jan 7 ban imports from Belarus</td>
</tr>
<tr>
<td>Palladium</td>
<td>26</td>
<td>19%</td>
<td>Automotive</td>
<td>n/a</td>
</tr>
<tr>
<td>Cereals (wheat &amp; meslin)</td>
<td>14</td>
<td>19%</td>
<td>Agribusiness</td>
<td>n/a</td>
</tr>
<tr>
<td>Aluminum (non-alloy)</td>
<td>21</td>
<td>19%</td>
<td>Automotive</td>
<td>n/a</td>
</tr>
<tr>
<td>Nickel</td>
<td>20</td>
<td>19%</td>
<td>Steel</td>
<td>n/a</td>
</tr>
<tr>
<td>Titanium</td>
<td>15</td>
<td>19%</td>
<td>Construction</td>
<td>n/a</td>
</tr>
<tr>
<td>Natural gas</td>
<td>16</td>
<td>19%</td>
<td>Battery</td>
<td>n/a</td>
</tr>
</tbody>
</table>

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, 720711,71101, 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.

Deep dive to follow
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

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1. KBS World (03/09) 2. WSJ (03/03) 3. Reuters (03/01) 4. WSJ (02/27) 5. Reuters (03/05) 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) 13. Forbes (03/06) 14. BBC (03/02) 15. Reuters (03/07)
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 substitute\(^4\)

Jet fuel prices up 27% month over month\(^1\), 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 Strait\(^2\)

Maersk, ONE, MSC, Hapag-Lloyd have suspended shipments to Russia & Ukraine\(^2\)

Bunker (marine fuel) up 84% vs. last year\(^3\), 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 freight\(^4\)

Rail lines through Russia closed: Asian exporters need to find new routes to EU\(^5\)

Ukrainian truck drivers returning to the Ukraine exacerbating EU driver shortage (e.g., 30%+ drivers in Poland from Ukraine\(^6\))

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
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 (HBI, 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

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Steel Supply risks – especially among European re-rollers – due to disruption of intermediate and finished steel products
Semiconductors | Already short global supply further exacerbated by raw material shortages will continue to impact auto and consumer electronics

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)

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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

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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 …

<table>
<thead>
<tr>
<th>Component</th>
<th>Difficulty in finding alternatives</th>
<th>Selected examples</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neon</td>
<td>High</td>
<td>Manufacturers of wire harnesses and other auto parts (Leoni, Sumitomo etc.)</td>
<td>German and Korean OEMs have stopped production due to lack of cables</td>
</tr>
<tr>
<td>Palladium</td>
<td>High</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Platinum</td>
<td>Moderate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iron ore</td>
<td>Low</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nickel</td>
<td>Low</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wires/Cables</td>
<td></td>
<td>OEMs have halted car production despite large capacity</td>
<td>With only 5% of local production exported, impact will be local &amp; limited</td>
</tr>
</tbody>
</table>

… 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

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 2021

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

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

How companies are responding today

### RECONFIGURE SUPPLY CHAIN

- **Aptiv**: Pre-emptively moved production of certain high-volume parts out of Ukraine in Jan 2022.
- **Nippon Steel**: Considering sources in Brazil & Australia for 14% of iron-ore pellets sourced from Russia/Ukraine.
- **Boeing**: Built globally sourced inventory of titanium to wind down relationship with Russia.

### RESPOND RAPIDLY TO DISRUPTION

- **Orchestrating beyond company**
  - **Nestle**: Executing business continuity procedures in Ukraine to ensure supply to consumers.
  - **Nokian Tyres**: Have intensified risk-mgmt scenario planning to include availability planning.
- **E2E risk management**
  - **Coca-Cola**: Performed scenario planning to prepare for potential supply chain disruption.

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

**RECONFIGURE SUPPLY CHAIN**

- **Redesign global network**
  - Redesign manufacturing and sourcing network to **reduce single-sourced items**, or sourcing from one region

- **Reset buffers**
  - Segment stock levels of intermediate goods and carry based on risk and criticality not only demand

- **Proactive supplier management**
  - Invest in key suppliers, form "open book" partnerships

**RESPOND RAPIDLY TO DISRUPTION**

- **Orchestrate beyond company**
  - Create partnerships in industry or buyer groups to **advocate for supplier resilience & transparency**

- **E2E risk management**
  - Link cyber risk of suppliers to own SC risk mitigation efforts
  - Explore multi-echelon SC transparency, to better map upstream risk

- **Simulation & scenarios**
  - Establish network level "digital twins" to scenarios

Source: Web search; BCG analysis
Teams across BCG are monitoring impact

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