War in Ukraine: Industrial Sector Impact

BCG Global Advantage & Industrial Goods Practice Areas

Prepared: 14 April 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).

...but is already impacting the global economy through the industrial sector

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 industrial sector impact of the war in Ukraine.

The situation surrounding Ukraine is dynamic and rapidly evolving - this document reflects information and analysis as of 14 April 2022. It is not intended as a prediction of future events and is shared only as a resource for BCG and client conversations.
Russia’s invasion of Ukraine is exacerbating a crisis among industries that were already struggling to cope with supply chain bottlenecks, soaring costs, and critical material shortages stemming from the pandemic. The ripple effects could include reduced automobile production, delays in big infrastructure projects, major shifts in global trade, and a food crisis in Africa.

Sectors that rely heavily on materials and natural gas from Russia and Ukraine are among the hardest hit. Global agriculture, for example, was under stress prior to the war because of high fertilizer prices. The war is driving up fertilizer costs even further, causing the biggest leap in food prices since 1990. The impact is especially dire in Africa, which imports much of its wheat from the two countries. Disruption in supplies of pig iron, semifinished steel, and natural gas will hobble production of finished steel. This, in turn, could affect major construction projects worldwide and automakers in the EU.

In other sectors, such as chemicals and transportation, war-related supply shocks could be more manageable as companies gradually shift to Asian and North American sources of energy and materials. As a result, an increased number of goods are likely to travel via ocean freight. And higher hydrocarbon costs could make green energy solutions more attractive across industries.
AGENDA

War in Ukraine: Industrial Impact

Perspective on industrial sector impact

› Cross-industry trends
› Selected sector impacts
› Implications for leaders

Prepared: 14 April 2022
Summary | Industrial Trends & Implications of the War in Ukraine

**Cross-industry trends**

This is a crisis on top of existing crises (e.g., Covid, supply chains), exacerbating price increases (e.g., oil & gas, fertilizers) and existing supply chain shortages (e.g., semi-conductors).

Critical industrial sectors exposed to rising costs and supply shortages (e.g., food crisis), but manageable risks and business upside for some segments (e.g., ocean freight, Greentech, clean energies).

| Sector implications | Agriculture | Food crisis driven by price and supply shock, compounded by high fertilizer prices and risking severe socioeconomic consequences, especially in Africa & Middle East |
| SECTOR IMPACT | Critical |
| Raw Materials | Scarcity of raw materials causes specific sector impacts (e.g., Steel) and second-order effects reach end users |
| Construction | Higher input costs & supply chain bottlenecks drive delays, and hinder infrastructure-led recovery |
| Chemicals | Manageable global impact of high input costs, but vulnerability and second-order impact for downstream chemical players and customer industries if potential cuts in Natural Gas supplies were to materialize |
| Automotive | Limited direct global sales impact; rising material, energy, labor costs stress supply base |
| Transportation | Change in trade patterns to cause modal shift to ocean freight and sustaining high rates |
| Greentech & Sustainability | Opportunity to accelerate adoption driven by energy independence, relatively more attractive economics, but constrained by supply in the short term |

| Implications for leaders | Business | Understand exposure and respond with contingency plans, proactively manage 360° risks, invest in resilience and review long-term strategy including geopolitical risk |
| Policymakers | Shape evolving situation, plan for socioeconomic resilience and review long-term industrial strategy & sector-specific policies |
War in Ukraine: Industrial Impact

AGENDA

Perspective on industrial sector impact

▶ Cross-industry trends
▶ Selected sector impacts
▶ Implications for leaders
War in Ukraine is a crisis on top of existing crises

Industrial sectors already under pressure…

**Supply chain bottlenecks**

- **Automotive sector** already affected by '21 chip shortages
  - 11.3M units of production lost in 2021 from chip shortage

**Rising prices**

- **Agriculture sector** had been facing surging fertilizer prices from demand, supply chain disruptions, energy prices, etc.
  - +210% in Ammonia fertilizer prices (Sept 2020 – Sept 2021)

**Geopolitical uncertainty**

- **Businesses** grappling with trade conflicts & geopolitical tensions
  - ~33% of Supply Chain Leaders moved business out of China (or plan to by '23) given need to build resilience & avoid tariff costs

… and War in Ukraine added further stress

**Added threat to semiconductors** as Ukraine produces a key input
  - ~70% of global Neon gas, a critical semiconductor component

**Fertilizer prices continue to rise**, as Russia, Ukraine & Belarus are significant exporters, already exacerbating the global food crisis
  - +45% in prices since War started; prices now 3-4x higher than in 2020

**Added pressure for companies exposed to sanctions, with assets exposed, and further global decoupling**

1. AutoForecast Solutions
2. CSIS.org
3. Farm Bureau
5. Gartner Survey

Source: BCG analysis and experience
**Negative industrial impact for sectors whose inputs are exposed to rising costs and supply shortages**

### Raw materials with high exposure

<table>
<thead>
<tr>
<th>Raw materials with high exposure¹</th>
<th>% of global exports</th>
<th>Top export markets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pig iron (nonalloy)</td>
<td>43%</td>
<td>44%</td>
</tr>
<tr>
<td>Anthracite coal</td>
<td>54%</td>
<td>24%</td>
</tr>
<tr>
<td>Semifinished product of iron or steel</td>
<td>27%</td>
<td>19%</td>
</tr>
<tr>
<td>Uranium; Plutonium²</td>
<td>35%</td>
<td>37%</td>
</tr>
<tr>
<td>Potassium chloride fertilizer</td>
<td>17%</td>
<td>39%</td>
</tr>
<tr>
<td>Mineral or chemical fertilizers³</td>
<td>25%</td>
<td>29%</td>
</tr>
<tr>
<td>Palladium</td>
<td>26%</td>
<td>28%</td>
</tr>
<tr>
<td>Cereals (wheat &amp; meslin)</td>
<td>14%</td>
<td>26%</td>
</tr>
<tr>
<td>Aluminum (non-alloy)</td>
<td>21%</td>
<td>39%</td>
</tr>
<tr>
<td>Nickel</td>
<td>20%</td>
<td>49%</td>
</tr>
<tr>
<td>Titanium</td>
<td>15%</td>
<td>39%</td>
</tr>
<tr>
<td>Natural gas</td>
<td>16%</td>
<td>65%</td>
</tr>
<tr>
<td>Crude oil</td>
<td>12%</td>
<td>48%</td>
</tr>
</tbody>
</table>

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 8. Source: STATISTA

### Industries primarily impacted

<table>
<thead>
<tr>
<th>Industries primarily impacted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials</td>
</tr>
<tr>
<td>Construction</td>
</tr>
<tr>
<td>Automotive</td>
</tr>
<tr>
<td>Materials</td>
</tr>
<tr>
<td>Greentech</td>
</tr>
<tr>
<td>Materials</td>
</tr>
<tr>
<td>Construction</td>
</tr>
<tr>
<td>Automotive</td>
</tr>
<tr>
<td>Chemicals</td>
</tr>
<tr>
<td>Agriculture</td>
</tr>
<tr>
<td>Materials</td>
</tr>
<tr>
<td>Automotive</td>
</tr>
<tr>
<td>Agriculture</td>
</tr>
<tr>
<td>Materials</td>
</tr>
<tr>
<td>Automotive</td>
</tr>
</tbody>
</table>

### Energy impact across sectors

#### Automotive
- Materials
- Construction
- Automotive
- Chemicals
- Agriculture
- Materials
- Automotive
- Agriculture
- Transportation
- Construction
- Automotive
- Materials
- Automotive
- Materials

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**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 8. Source: STATISTA
Different implications across industrial sectors

<table>
<thead>
<tr>
<th>Trends</th>
<th>Critical</th>
<th>Manageable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply disruption</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Substitution complexity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price volatility</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opportunity in response</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Agriculture**: Global food supply and price shock; obstacles to adjust short-term production
- **Materials**: Scarcity of raw materials causes specific sector and second-order industrial impacts
- **Construction**: Materials disruption and higher input costs cause large-scale projects delays
- **Chemicals**: Manageable global risks, but vulnerability to potential cuts in Natural Gas
- **Automotive**: Limited direct global sales impact; rising material, energy, labor costs stress supply base
- **Transportation**: Trade changes drive route shift and higher costs; opp. for ocean freight players
- **Greentech & Sustainability**: Short-term shortages but not rare earth; opp. to minimize energy dependency

1. Natural Gas. Source: BCG analysis and experience
War in Ukraine: Industrial Impact

AGENDA

Perspective on industrial sector impact

➢ Cross-industry trends

➢ Selected sector impacts

➢ Implications for leaders

Prepared: 14 April 2022
Agriculture | War-based shock compounds food security crises, exacerbated by droughts in Africa, Middle East, and Central Asia

Exposure of global cereal & fertilizer exports

**Example: Cereals**

*Volume of exports (M ton)*

<table>
<thead>
<tr>
<th></th>
<th>Wheat (2021)</th>
<th>Wheat (2022)</th>
<th>% of world exports</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24</td>
<td>35</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>29%</td>
</tr>
</tbody>
</table>

**Example: Fertilizers**

*Volume of exports (M ton)*

<table>
<thead>
<tr>
<th>Fertilizer Type</th>
<th>2021</th>
<th>2022</th>
<th>% of world exports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muriate of Potash</td>
<td>11</td>
<td>11</td>
<td>40%</td>
</tr>
<tr>
<td>Urea</td>
<td>7</td>
<td>11</td>
<td>13%</td>
</tr>
<tr>
<td>Ammonia</td>
<td>4</td>
<td>5</td>
<td>22%</td>
</tr>
</tbody>
</table>

Exacerbation of pre-War price increases

**Change in price since Dec. 2020**

- **Wheat prices**
  - Conflict break-out
  - +80% to +100%
  - +63%

- **Fertilizers prices**
  - Conflict break-out
  - +200%
  - +204%

Africa, ME, and CA face historic droughts

- **Severe droughts** in Africa & MENA compound import & local supply shock
- Agricultural regions are facing historic drought levels
  - Less drought
  - More drought

However, other markets with **record harvests** (e.g., India, Australia) may balance supply gap

Source: Gro Intelligence; Global Data; Bloomberg Green Markets Fertilizer Index; BCG Analysis and case experience
Food shock

First-order impact

+13% food prices increase, highest FAO Food Price Index since inception in 1990\(^1\)

Food quantities unavailable, and obstacles to local substitution (e.g., Africa & ME where 50% of cereal imports come from Ukraine/Russia\(^2\))

Reinforcing loop

+40% increase in fertilizer prices\(^3\)

Farmers to minimize fertilizer use and pivot to fertilizer-light crops

Compounding effect of other shortages (e.g., fuel) to limit farmer spending

Second-order impact

Change in trade patterns

Shock to livestock prices & production

Shock to household spending (e.g., 43% of family income spent on food in Africa\(^4\))

Potential social tensions, as 276 M+ people are facing acute hunger and 44 M are on the brink of famine\(^5\)

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Agriculture | Potential food security crisis in Africa with deep humanitarian implications

### Africa exposure to Russia and Ukraine

**Example: Wheat imports** (Million Ton)

<table>
<thead>
<tr>
<th>Country</th>
<th>Russia</th>
<th>Ukraine</th>
<th>Rest of the world</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egypt</td>
<td>5,195</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nigeria</td>
<td>2,146</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morocco</td>
<td>1,279</td>
<td>530</td>
<td>467</td>
</tr>
<tr>
<td>Tunisia</td>
<td></td>
<td>2,146</td>
<td></td>
</tr>
<tr>
<td>Sudan</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Countries already experiencing high price increases

**Example: Food prices in Kenya** (% increase, March 2022 vs 21)

- Cooking Gas (13kg): 38%
- Cooking oil (1Litre): 35%
- Collard greens (1kg): 20%
- Wheat flour (2kg): 18%

### Potential humanitarian crisis in Africa

- **Strong impetus to shift staple foods to locally grown cereals** (e.g., millet, sorghum)
- **Outsized economic and social development impact** given high proportion of income going on food spend
- **Pressure on government investment in other priorities** (e.g., education, health, debt reserving)
- **Lower effectiveness of humanitarian aid** given Ukraine is a major supplier for World Food Program (+50% wheat supplies)

Source: OEC; WTO; BCG Analysis and case experience

Prepared: 14 April 2022
Materials | Commodities shock with second-order industrial impact, but also influenced by balancing factors such as mining output substitution

Raw material shocks lead to 2nd-order impacts across industrial uses

<table>
<thead>
<tr>
<th>Material</th>
<th>Exposure of global exports</th>
<th>Use in components &amp; end products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pig Iron</td>
<td>64%</td>
<td>Steel, structural components</td>
</tr>
<tr>
<td>Anthracite Coal</td>
<td>56%</td>
<td>Power generation, residencial/commercial heating</td>
</tr>
<tr>
<td>Semifinished iron and steel</td>
<td>38%</td>
<td>Steel, structural components, electromagnets</td>
</tr>
<tr>
<td>Uranium; Plutonium</td>
<td>35%</td>
<td>Electricity, radioisotopes used in medical and defence industries</td>
</tr>
<tr>
<td>Potassium chloride</td>
<td>34%</td>
<td>Fertilizers, medications</td>
</tr>
<tr>
<td>Palladium</td>
<td>26%</td>
<td>Process catalysts, Electrical Components</td>
</tr>
<tr>
<td>Aluminium</td>
<td>21%</td>
<td>Cables, electrical components</td>
</tr>
<tr>
<td>Nickel</td>
<td>20%</td>
<td>Steel products, EV batteries</td>
</tr>
<tr>
<td>Titanium</td>
<td>17%</td>
<td>Electronic circuits, heat exchangers, paint</td>
</tr>
<tr>
<td>Natural gas</td>
<td>16%</td>
<td>Key industrial heating &amp; energy source, chemical feedstock</td>
</tr>
</tbody>
</table>

Supply risks…

⚠️ Conflict-driven production disruptions and extended trade restrictions

⚠️ Physical inability to transport and high freight rates

…but also balancing factors

⚠️ Substitution by global mining & materials players ramping up production (e.g., critical minerals & materials)

⚠️ Potential demand reduction due to parallel factors reducing strain on markets (e.g., interest-rate driven decrease in capex investments)

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1. Russia, Ukraine, Belarus share of global exports per material (see pg. 9 for detailed references)

Note: Only significant commodities included. Source: Expert inputs; BCG Analysis & experience
Steel deep-dive | Most impact on EU rerollers and USA EAF\(^2\) mills; Natural gas potentially unviable in EU to bridge green steel transition

Higher prices & costs…

...with varying impacts across steelmaking regions

### First-order impact

**European Union**
- Semis crunch impacting reroller production and leading to increase in HRC\(^3\)/plate prices
- EAFs\(^2\) were already suffering from high power and metallics costs, crisis worsens cost position

**USA**
- Shortage of virgin metallics like pig iron/DRI\(^3\) for EAFs to produce high quality products
- New avenues need to be explored to supply increasing fleet of flat steel EAF capacity

**China**
- Potential redirection of Russian semis and finished steel exports to China
- Low domestic steel prices mean room for arbitrage for exports to EU despite duties

**Others**
- Low-cost Asian mills eye lucrative western markets to fill supply void of Russian exports
- Domestic markets of countries neutral to Russia could see influx of Russian imports

### Second-order impact

**Producers**
- High NG\(^4\) prices make DRI production with NG potentially unviable in EU. DRI imports from regions with low NG cost an alternative solution.
- EU players could accelerate green H2 DRI production by leveraging support under REPowerEU

**Users**
- Looming shortage of steel for wind towers putting EU’s renewable push at risk
- Series of supply chain shocks (like current crisis, covid, Suez blockage etc.) could lead to increased regional sourcing by end users
## Construction | Most impact on public & large-scale infrastructure, potentially hindering economic recovery efforts

### First-order impact

**Material costs increase driving:**
- Terms renegotiations in multi-year contracts
- Substantial delays in new bids
- Players withdrawing from new bids limiting price competition

**Localized impact:**
- Global impact exacerbated local shortages (e.g., ~100k Ukrainian workers returning from Poland)

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### Second-order impact

- **Limited effectiveness** of public infrastructure as **channel for economic recovery support**

- **Potential crowding-out effect** in infra investment if **interest rates increase** substantially

- **Higher attractiveness of green energy solutions**, especially for residential projects and building operation (e.g., solar panels vs fuel-based electricity)

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**Public infra. & commercial constructions**

- Residential construction: **Limited impact**, minor delays due to already existing and exacerbated supply bottlenecks

- Residential renovation: **Minor "wait-and-see" effect** delaying renovation efforts during high input prices period

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Source: BCG Experience and analysis
DEEP-DIVE

German chemical industry exposed to Russia Natural Gas as energy & feedstock source

German Chemicals strongly rely on Natural Gas…

Energy consumption, Germany Chemical industry

...and is exposed to Russian supplies

Relative share of gas used in Chemicals

Natural Gas¹ | Heat | Electricity | Others²

44% | 25% | 13% | 18%

Relative limited feedstock impact

Gas consumption in Chemicals

Russian gas | Energy | Feedstock

59% | 41% | 73% | 27%

1. Incl. electricity generation from Natural Gas. Does not include feedstock consumption of Natural Gas. 2. Incl. renewables, nuclear power & others. Source: AGEB; Destatis; VCI; BCG analysis

First and second order impacts

- **Energy shortage** risk for chemical sector if potential cuts in Russian Natural Gas were to materialize
- **Immediate shock** to German economy, as chemical industry is a key employer
- Given global leading position of German chemical players, potential second-order shocks in key inputs for downstream chemical sector
- Potential ripple effects for key inputs for global economy exacerbating supply shocks (e.g., fertilizer, plastic packages)
### First-order impact

<table>
<thead>
<tr>
<th>End market impact</th>
<th><strong>Limited direct impact on global vehicle sales</strong> (Russia accounted for only 1.7M of new vehicles sold in 2021)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>More acute impact on 3 players that account for &gt;70% of sales</td>
</tr>
<tr>
<td></td>
<td>Inflationary / recessionary pressures increasing, but <strong>automotive sales insulated due to semiconductor-driven pent-up demand</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Asset exposure</th>
<th><strong>Automotive manufacturers (OEMs) and suppliers in Russia facing potential write-offs, or Government seizure of assets</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nonetheless, exposure relatively minor, with ~$5B of asset exposure across major OEMs representing ~0.2 to 2% of total assets¹</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supply shortage</th>
<th><strong>22 foreign automotive suppliers with presence in Ukraine</strong> (4th largest supplier of wire harnesses to Germany)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Resourcing of components will <strong>minimize long-term impact</strong></td>
</tr>
<tr>
<td></td>
<td>Russia and Ukraine account for <strong>significant source of core raw materials</strong> (e.g., Neon, Nickel, Palladium); war driving higher prices, do not however anticipate outright risk to production</td>
</tr>
</tbody>
</table>

### Second-order impact

- **Potential redistribution of global markets**, with Chinese suppliers and OEMs replacing disrupted component and finished vehicle supply in Russia
- **While OEMs will be able to pass on rising costs to consumers, suppliers will need support** as their balance sheets are vulnerable to higher energy, material, & labor costs
- **Higher fuel costs will drive accelerated shift to EV** (impact offset by increase in Nickel costs)

**Reinforced need to assess geopolitical risk** when developing supply chain strategy and prioritizing which markets to focus

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1. For OEMs that have reported Russian asset exposure (4 OEMs) as of April 6. Source: NYTimes, Broker research, HIS Markit, World Bank, IFS, HSE Consensus forecast; BCG experience & analysis
Automotive | Crisis and global nature of industry elevates need for a revaluing of risk and the building of more resilient supply chains

High exposure to foreign companies in major trade blocs

- Interconnectivity of global value chains demands a much more robust assessment of risk
- Events of the last few years have brought more fully into light the costs of single source risk and prioritizing lowest landed cost
- Looking ahead, imperative that companies incorporate a broader range of criteria for geographic markets and sourcing selection...
- ...focusing more fully on geopolitical risks and supply chain resilience

1. IHS Markit Light Vehicle Production (2021); 2. UN Com Trade
8% of global trade volume at risk

<table>
<thead>
<tr>
<th>Region</th>
<th>Export Volume to Import Volume</th>
<th>% of Regional Import Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe¹</td>
<td>263 539</td>
<td>14%</td>
</tr>
<tr>
<td>Asia</td>
<td>118 503</td>
<td>4%</td>
</tr>
<tr>
<td>Americas</td>
<td>3 84</td>
<td>6%</td>
</tr>
<tr>
<td>RoW</td>
<td>2 60</td>
<td>12%</td>
</tr>
<tr>
<td>Total²</td>
<td>386 1,186</td>
<td>8%</td>
</tr>
</tbody>
</table>

- **Seaborne**
- **Overland²**
- **Airborne³**

**EXAMPLE**
Natural Gas

**EXAMPLE**
Wheat

War-induced changes in trade flows lead to transport routes transformation

1. EU minimizes hydrocarbon imports (REPowerEU)
2. EU substitutes imports with alternative sources
3. Russia-China Natural Gas trade intensifies (via ocean freight)

1. Disruption to Russia & Ukraine production & export routes
2. Russia-China exports intensify, driving in-route lower prices and reshuffling of trade patterns (e.g., from India)
3. Reduced Russia/Ukraine exports to Africa/ME could be backfilled by Americas and Australia

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1. Including Russia, Ukraine and Belarus, accounting for 87 M ton of trade among them
2. Includes rail, road & pipeline (esp. relevant in energy trade in RUS-EU)
3. Limited amount of airborne cargo, 162k ton to World. Source: BCG Analysis and experience. Note: excludes airborne due to negligible value
Transport | Ocean freight to absorb modal shift, while increase in uncertainty and trade costs drive broader implications

**First-order impact**

<table>
<thead>
<tr>
<th>Ocean Freight</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tanker</strong></td>
</tr>
<tr>
<td>Lost EU pipeline energy imports <strong>to be backfilled by LNG and crude oil imports</strong> from 3rd countries, driving freight rate increase</td>
</tr>
<tr>
<td><strong>Container</strong></td>
</tr>
<tr>
<td>East-to-West volume shift from disrupted Russian rail routes <strong>Sustained high rates</strong> &amp; more pressure on <strong>container shortages</strong></td>
</tr>
<tr>
<td><strong>Bulk</strong></td>
</tr>
<tr>
<td><strong>Commodities shock</strong> in short term, e.g., agriculture &amp; iron ore Russian exports to Asia <strong>shifting from ocean</strong> to rail &amp; road Global supply substitution will <strong>impact demand rate outlook</strong></td>
</tr>
<tr>
<td><strong>Rail &amp; road</strong></td>
</tr>
<tr>
<td><strong>Asia-Europe volume reduced</strong> as Southern Route (Central Asia) cannot handle all Northern Route (Russia) volume <strong>Low impact to inland routes</strong>, key to distribute seaborne trade</td>
</tr>
<tr>
<td><strong>Air freight</strong></td>
</tr>
<tr>
<td>East-to-West supply chain delays and risks lead to <strong>increased emergency air freight demand</strong> <strong>Longer times</strong> due to closed airspace, leading to lower capacity</td>
</tr>
</tbody>
</table>

**Second-order impact**

- **Varying ability to substitute commodity shortages** depending on seaborne routes
- **Negative decarbonization impact in short term** due to shift to ocean freight vs pipeline
- Higher hydrocarbon costs and better electrification economics push **green transition** (e.g., electrification of heavy-duty transport, renewable fuels)
- Higher trade costs and uncertainty on shortages & times accelerate **manufacturing re-location**

Source: BCG Analysis and case experience

Prepared: 14 April 2022
Greentech & Sustainability | Opportunity to accelerate the adoption of 'green solutions' across industries

Push of sustainable solutions, although balanced

Political & business support of green energy sources & technologies to secure independence
- e.g., new 'Osterpaket' legislation in Germany with new RE subsidies and simplified permitting

Relatively more attractive economics of 'green solutions' given higher hydrocarbon prices meeting increasing performance of green technologies, e.g., heat pumps, xEVs

Balancing factors such as supply shortages and higher costs (e.g., Nickel) might delay the short-term transition to sustainable technologies

Examples across industries

Agriculture | Change in consumption habits and push to locally sourced, sustainable food

Materials | Green H2 as feedstock and energy source in metal transformation processes (e.g., green steel)

Construction | Solar panels for residential projects, heat pump for heating (savings through 3x efficiency vs. gas/oil)

Chemicals | Opportunity to develop alternative fuels and green chemical products

Automative | Acceleration of shift to xEVs (e.g., Q1/22 US xEV sales w/ record growth while overall market down 15%)

Transportation | Electrification of light/medium duty road transport, increased use of renewable fuels,

Additional focus on recycling and improving collection & reverse distribution to optimize supply of scarce materials (e.g., Nickel), but higher complexity and cost

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War in Ukraine: Industrial Impact

AGENDA

Perspective on industrial sector impact

➢ Cross-industry trends
➢ Selected sector impacts
➢ Implications for leaders
Industrial implications for business leaders and policymakers

**BUSINESS LEADERS**

**Near term**
- Understand exposure & respond
- Proactively manage risks
- Review long-term strategy

**Longer term**
- Strengthen 360° risk management and invest in supply chain, production, technology & energy resilience
- Assess long-term strategy and include geopolitical risk as decision-making criteria for footprint and investments

**POLICYMAKERS**

**Near term**
- Shape the evolving situation
- Plan for economic resilience
- Review long-term industrial strategy

**Longer term**
- Shape response against geopolitical and business risks, identify immediate actions and launch collaborations with other governments and private sector
- Design response plans to economic risks (e.g., energy shortages) in collaboration with industrial players; identify social & humanitarian actions (e.g., emergency food supplies)
- Review sector-by-sector prospects and design investment & growth plans to strengthen strategic autonomy

Source: BCG experience & analysis
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