War in Ukraine: View on Energy Impact

BCG Global Advantage and Energy Practice Areas

Prepared: 17 March 2022 – Confidential: Limited Distribution
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 energy impact of the war in Ukraine.

The situation surrounding Ukraine is dynamic and rapidly evolving - this document reflects information and analysis as of 17 March 2022. It is not intended as a prediction of future events and is shared only as a resource for BCG and client conversations.
War in Ukraine: Impact on Energy

AGENDA

Deep-dive: First view of impact on Energy

› Context and current situation

› Impact on energy supply

› Implications: consumers, companies & governments
Prior to the war, global energy already "tight" with inflationary pressures

**Strong demand recovery from COVID began in 2020**

Global Energy Demand

<table>
<thead>
<tr>
<th></th>
<th>Natural gas</th>
<th>Oil</th>
<th>Coal</th>
<th>Electricity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>147</td>
<td>143</td>
<td>148</td>
<td></td>
</tr>
<tr>
<td>2019</td>
<td>192</td>
<td>174</td>
<td>191</td>
<td></td>
</tr>
<tr>
<td>2021</td>
<td>154</td>
<td>142</td>
<td>154</td>
<td></td>
</tr>
</tbody>
</table>

**Inventories substantially below pre-COVID levels**

Global O&G inventories

- Natural gas (1,000 m³ LNG)
- Oil (1,000 BBLs)

<table>
<thead>
<tr>
<th></th>
<th>Jan 2020</th>
<th>Jan 21</th>
<th>Jan 22</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>5,761</td>
<td>1,440</td>
<td>980</td>
</tr>
<tr>
<td>2019</td>
<td>1,495</td>
<td>1,210</td>
<td></td>
</tr>
<tr>
<td>2021</td>
<td>4,095</td>
<td>4,515</td>
<td></td>
</tr>
</tbody>
</table>

**Insufficient investment: reducing capex in last 5y**

Global upstream O&G Capex ($B)

<table>
<thead>
<tr>
<th></th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural</td>
<td>5%</td>
<td>410</td>
<td>450</td>
<td>441</td>
<td>309</td>
</tr>
<tr>
<td>Gas</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>341</td>
</tr>
</tbody>
</table>

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Note: LNG: liquid natural gas; BBL: Barrel, TTF: Title Transfer Facility, mmbtu: Million British thermal units
Source: IEA, GIE Aggregated LNG Storage Inventory, Reuters, Bloomberg, IEF, IHS Markit, Yahoo, Trading Economics, BCG Analysis
Russia plays an important role in the global energy market, and the war heightens supply risks.

### Russia's role in global energy market

#### % global supply/exports

<table>
<thead>
<tr>
<th></th>
<th>Gas</th>
<th>Oil</th>
<th>Coal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply</td>
<td>16.6% Russia</td>
<td>12.3% Supply</td>
<td>5.2% Supply</td>
</tr>
<tr>
<td></td>
<td>83.4% Others</td>
<td>87.7% Others</td>
<td>94.8% Others</td>
</tr>
<tr>
<td>Exports</td>
<td>25.3%</td>
<td>12.0%</td>
<td>17.8%</td>
</tr>
<tr>
<td></td>
<td>74.7%</td>
<td>88.0%</td>
<td>82.2%</td>
</tr>
</tbody>
</table>

- **Gas**: Second globally behind US, Main exporter in Europe; Norway second.
- **Oil**: World’s 3rd largest oil producer (after US, Saudi Arabia), World’s largest oil exporter.
- **Coal**: World’s 2nd largest coal reserves, 6th largest producer, 3rd largest coal exporter.

### Russia supply by end market

#### % supply from Russia

- **Gas**
  - Finland: 100% Supply, 99% Exports
  - Bulgaria: 81% Supply, 78% Exports
  - Poland: 54% Supply, 44% Exports
  - Hungary: 33% Supply, 33% Exports
  - Germany: 8% Supply, 5% Exports
  - Turkey: 5% Supply, 2% Exports
  - Italy: 5% Supply, 2% Exports
  - France: 2% Supply, 1% Exports
  - Netherlands: 2% Supply, 1% Exports

- **Oil**
  - Finland: 78% Supply, 78% Exports
  - Bulgaria: 56% Supply, 55% Exports
  - Poland: 51% Supply, 51% Exports
  - Hungary: 26% Supply, 23% Exports
  - Italy: 6% Supply, 4% Exports
  - Germany: 2% Supply, 1% Exports
  - Turkey: 1% Supply, 1% Exports
  - France: 1% Supply, 1% Exports

- **Coal**
  - Italy: 36% Supply, 36% Exports
  - France: 28% Supply, 28% Exports
  - Poland: 24% Supply, 24% Exports
  - Germany: 15% Supply, 15% Exports
  - Hungary: 8% Supply, 6% Exports
  - Bulgaria: 4% Supply, 4% Exports

### Increased volatility

- **Gas**: Price volatility (% wk/wk change)
- **Oil**: Price volatility (% wk/wk change)
- **Coal**: Price volatility (% wk/wk change)

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Pricing - Oil | Significant crude and oil volatility, with the market pricing in risk of long-term disruption of Russian flows

Disruptions to Russian Energy sector…

1. **Geopolitical risk**: uncertainties around the evolution of the conflict

2. **Liquidity pressure** due to sanctions on Russia - increases hedging and margin calls

3. **Unwillingness of most buyers & traders** to take Russian oil given supply chain risks

4. **Reputational risk** prompting major oil producers to exit/reduce Russia exposure

…has caused global volatility across oil markers and relative premiums

**Global Crude Oil Volatility Index**

- **Jan 2022**: 30
- **Feb**: 40
- **Mar**: 60

**Discount of Russian Ural crude (relative to price of Brent barrel as base)**

- **Jan 2022**: 0%
- **Feb**: -10%
- **Mar**: -30%

Sources: EIA, Company filings and press releases; Refinitiv, Refinitiv Eikon, Reuters, UK Government, Government of Canada, The White House, CME, BCG Analysis
Pricing - Gas | Low European storage levels forcing a response to ensure security of supply, markets pricing in future risk of disruption

Historically-low gas inventories in Europe, with the EU considering imposing forced filling requirements…

European gas storage utilization (%)

EU’s consideration of 90%+ storage filling requirement to create immediate buying pressure

Currently spikes are not rooted in adverse supply impacts, but instead driven by need to increase/buffer inventories

1. Liquid Natural Gas; 2. Title Transfer Facility, a virtual trading point for natural gas in the Netherlands; 3. mmbtu = Metric Million British Thermal Unit (unit of heat)

Supply shock – Oil | Full shutdown of Russian oil exports unlikely given global importance and energy transition timescale

Full shutdown of Russian oil exports unlikely given high risk...

Shutdown would risk large global supply shock, price surges & demand destruction – thus risk of leakage of Russian crude to market

...and years-long 'energy transition' project timelines

Indicative timeline range (number of years for new mid-sized projects in each energy transition/renewables capacity area)²

1. Quadrillion British thermal units (the amount of energy required to raise one pound of water one degree Fahrenheit); Notes: Scenarios include BP, Shell, and IEA; 2. Timeline ranges are based on pre-Ukraine estimations for new projects (not projects where work is under way); 3. Average total timeline is indicative average based on average-size projects in the space. Time can vary based on scale and scope; 4. Potential shorter timelines assumes speeding up of planning, permitting and financing stages, yet execution stage of these projects unlikely to be able to be reduced significantly; Sources: Wood and Mackenzie, Feb 2022; Resources for the Future Global Energy Outlook; Kpler; Refinitiv Eikon

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Global Scenarios for Oil & Liquids Production, QBtu¹

- Actuals prior to the war in Ukraine
- Current scenarios prior to war in Ukraine
- Global production without Russia

Difficult to replace Russia’s 12% of global supply overnight

Average total timeline³

Potential shorter timeline⁴

Shorter timelines contingent on strong government & regulator support (e.g., reducing planning, permitting and financing timelines)
Supply shock – Gas | EU reliance on Russian gas increases its vulnerability, fueling an accelerated push for alternatives

RePowerEU: EU have launched plans to reduce Russian gas import dependence

66% target reduction in Russian natural gas supply by end of 2023

Requires strong coordination to realize, given risks (e.g., intense competition for LNG from Asia, pace of Net-Zero transition)

90% Long-term reduction target of gas consumption requires front-loading of already aggressive plans

Source: IEA, Oxford Institute for Energy Studies, ENTSOG Transparency Platform, Eurostat, Gas Infrastructure Europe, Rystad, Aurora, Broker reports, BCG analysis
Finance across gas purchases

$90bn required to fill gas storages this year

Supply Risk

Renewable Energy bottlenecks
Growth in renewable development will create supply-chain pressure & risk of worse inflation
Further, $700+ bn financing required for renewable energy plan

France nuclear capacity and utilization constraints
EU plans rely on French capacity at/above current level. However, no capacity step change is expected till 2030s

LNG market is already tight
Competitive pricing between EU & APAC for LNG
Higher logistics costs, as LNG supply will most likely come from the US and Qatar

Transmission system operators’ risks
Difficulty for oil and gas transport network to fully accommodate growth demand without risking its integrity

Demand Risk

Demand increase – winter risk
Current plans based on “normal” winter seasons, not considering risks of colder winter and higher energy demand

Financing across gas purchases
$90bn required to fill gas storages this year

Notes: LNG = Liquid Natural Gas; Source: The Wall Street Journal, Mar. 2022, Forbes, Feb. 2022, BCG experience and analyses
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Energy market pricing and supply shocks make products more expensive to produce and buy, as governments seek to improve energy security.

### Consumers

Energy is outsized driver of inflation currently: 7% of CPI\(^1\) yet account for 24% of inflation\(^2\)

Rising energy prices **reducing discretionary spend**

Subsidies increasingly likely, where not already in place

### Companies

**High energy-intensity** industries (e.g., steel, cement, chemicals, fertilizers, travel, freight) experience cost increases presenting risk to profitability

Businesses **assessing impact** and ensuring continuity of business-critical operations

**Mid-to-long-term**, likely positive impact on climate goals – yet need to de-average impact by country

### Governments

Extend of government actions vary – focus on energy security (esp. EU)

Emphasis on reducing price pressures, stockpiling, diversifying energy supply

Will impact **speed of transition to renewables** – impact varied by country

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1. US Bureau of labor statistics; 2. in Feb 2022: BCG macroeconomic analysis; Source: BCG analysis and experience
Consumers | High energy prices impacting total demand - but governments likely to support consumers and small businesses

Higher oil & gas prices impacting consumer demand

Brent crude oil price (left axis, $/bbl)

Consumer sentiment index (right axis, Q1 1966=100)


0 20 40 60 80 120 160

Consumers likely to reduce discretionary spend:
- 30% say rising gas will greatly affect their decision to travel
- 59% likely to change lifestyle if gasoline price rises by ~20%

Governments responding with direct subsidies

- €0.17 per liter reduction in tax on fuel
- €0.11 per liter of diesel from April 1
- Value added tax on electricity cut from 21% to 9% from July 1
- Expected to unveil full measures
- Mandated EDF to only adjust tariffs by 4%
- Already spent €20bn to moderate gas and power costs
- Proposals of a “crisis discount” (fuel subsidy)
- If approved, gas prices cut €0.20+ per liter
- Imposed prices caps on some basic foods, fuel and mortgages, extending a cap already in place on household energy
- Several states considering reducing or suspending gas tax – bills already proposed and are being voted on soon

1. Survey of 1,000 consumers over the age of 18 by Longwoods International regarding next 6mos ; 2. According to survey conducted by American Automotive Association; Other Source: BCG Center of Macroeconomics, Forbes (Mar. 10, 2022); The Wall Street Journal (Mar 15, 2022); ABC News (Mar.15, 2022); Reuters (Mar 15 2022); Dutch News (Mar.11, 2022); Reuters, Mar 2022, Euro news (March 10, 2022), Financial Times (Feb 18 2022)
Companies | High energy-intensity industries will experience the largest cost impact

**Steel**
Higher costs in energy will increase steel prices

Energy represents **10-20% of total costs in steel production in EU** (varies by region and year) ¹

**Chemicals & fertilizers**
Ammonia - for which **72-85% of cost is natural gas**³–⁴ and other chemicals are critical for production – already significant price increases

**Cement**
Higher costs in energy will increase cement prices

Energy is **10-30% of total cement costs**, depending on region and year⁴

**Air Travel & Freight**
Jet fuel prices up **27%** month over month⁵, likely to drive cargo rates up

Airspace closures leading to fewer, longer (more fuel consuming) flights

**Shipping Freight**
Bunker (marine fuel) up **84% vs. last year**⁶ where fuel represents ~**45% of total cost** for shipping

Further cost increases due to delays (lane closures, & reshuffling of trade flows)

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**Construction, auto, rail, shipbuilding, machinery, metal, equipment** impact

**Global food supplies, chemical factories, auto, etc.** will be negatively impacted by input prices & less supply

**Construction and infrastructure** impacted

**Logistics and consumer travel cost** impacted

**Shifts in air networks** to optimize aircraft utilization as travel spending reduce

**Most traded goods** affected, especially long-haul freight⁷

Route re-configurations for capacity optimization

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Further inflationary pressures, erosion of margins & conservative capex are likely as energy prices remain high

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¹. OECD [link] ². USDA [link] ³. cement [link] ⁴. IATA: Europe-Asia, Asia-North America most heavily hit by airspace closure, Based on CTKs (cargo ton kilometers) over the past 12 months
⁵. Freightwaves: Ship fuel spikes to historic $1,000/ton mark as war fallout worsens, ⁶. OECD [link], BCG Analysis

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Companies | Assess first- and second-order impact, devise mitigation plans and build resilience in the mid term

**Short-term**

- **Assess exposure and risks to input costs**, ensure operational business continuity
- **Partner closely across value chain** to improve transparency. Assess reputational & operational impact (incl. suppliers of suppliers)

**Mid-to-long-term**

- **Assess second-order impact for your customers**. Prioritize impacted customers and develop differentiated mitigations plans
- **Understand investment shifts and capital implications** (e.g. RePowerEU) in your industry – balance planning and flexibility
- **Build agility in scenario planning** to assess similar external shocks and their impact (e.g., network level 'digital twins')
- **Review climate goals**, assess impact, develop a mitigation plan by country – as governments accelerate or decelerate transition

Source: BCG analysis and experience
Governments | Key levers should be utilized to respond to energy crisis based on individual nation's position

Governments exposed to risk differently...

... and response highly dependent on country's position

More susceptible to supply shocks and market volatility

**Potential steps:**
- Stockpiling energy resources
- Identifying new short-term suppliers (e.g., LNG from US)
- Potential delay of coal & nuclear power decommissioning
- Investing in renewables for longer term independence

Less susceptible to supply shocks; equally to price increases

**Potential steps:**
- Implement short-term fiscal stimulus, subsidies, price caps
- Invest in renewables for longer term price reduction – and support of other less advanced countries in the space

Reducing regulatory hurdles, permitting periods, legal procedures needed to increase speed of supply increases

Note: TJ = terajoule; AT = Austria, BE = Belgium, DK = Denmark, ES = Spain, FR = France, GR = Greece, IE = Ireland, IT = Italy, HR = Croatia, NL= Netherlands, NO = Norway, PT = Portugal, RO = Romania, UK = United Kingdom;
Source: Eurostat, Supply, transformation, and consumption of gas; Primary Energy Consumption; Imports of natural gas by partner country, Reuters. Also, Forbes, Washington Post, Council of the European Union, the Wall Street Journal, European Commission, Euronews, Italian Government. ENTSOG, Bruegel 1. Imports which are consumed within a country (which are not traded beyond country border)
Governments | EU and key member-states are implementing concrete policies to reduce short-term and long-term dependence on Russia

**Short-term**

**Implement fiscal stimulus & price caps**
- Enact short-term measures (subsidies, tax cuts) to shelter vulnerable electricity consumers

**Diversify & increase energy supply**
- Enact minimum gas storage obligations
- Identify alternative sources
- Maximize generation from low-emissions sources: e.g., bioenergy
- Stockpile energy resources

**Increase efficiency, reduce demand**
- Accelerate energy efficiency in industry and in heating pumps
- Encourage a temporary thermostat lowering and highway slowdowns – to reduce energy usage

**Expand renewable capacity**
- Accelerate the deployment of new renewable projects
- Step up efforts to diversify and decarbonize sources of power system
- Enable renewables for energy independence

**Mid-to-long-term**

- Capped energy bill price increases to 4%, significantly under market
- Increasing gas imports from Algeria and Azerbaijan and increasing use of LNG terminals
- RePowerEU advised turning down thermostats 1°C to reduce electricity demand
- Plans to expand renewable capacity & legislate full supply from renewables by 2035

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