

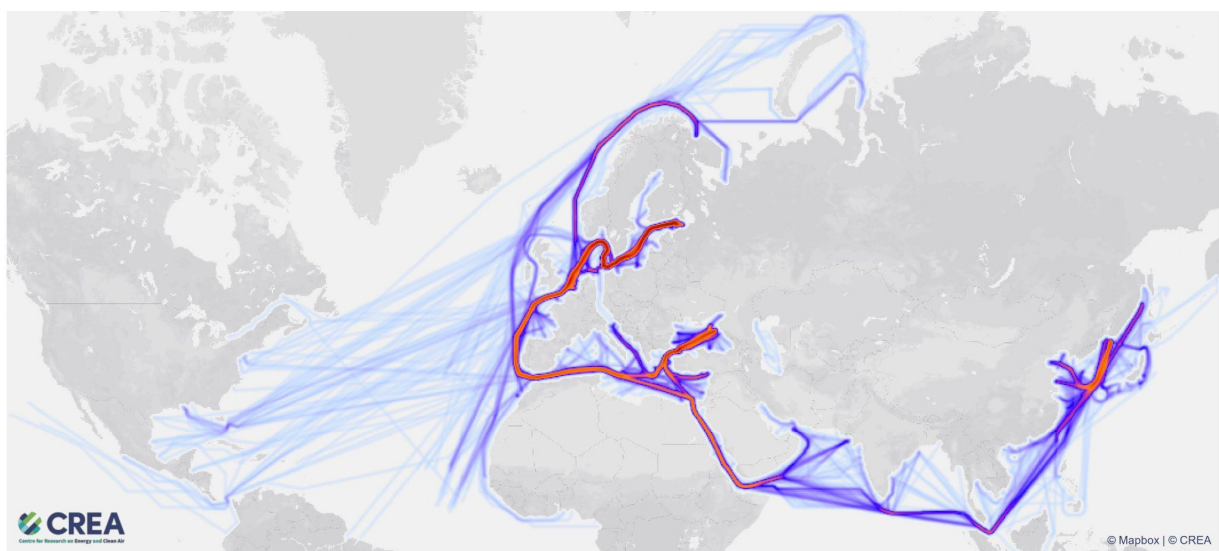
Financing Putin's war: **Fossil fuel exports from Russia in the first six months of the invasion of Ukraine**

August 24 marked Ukraine's 31st Independence Day, and the passage of six months since the beginning of Russia's full-scale aggression aiming to end that independence.

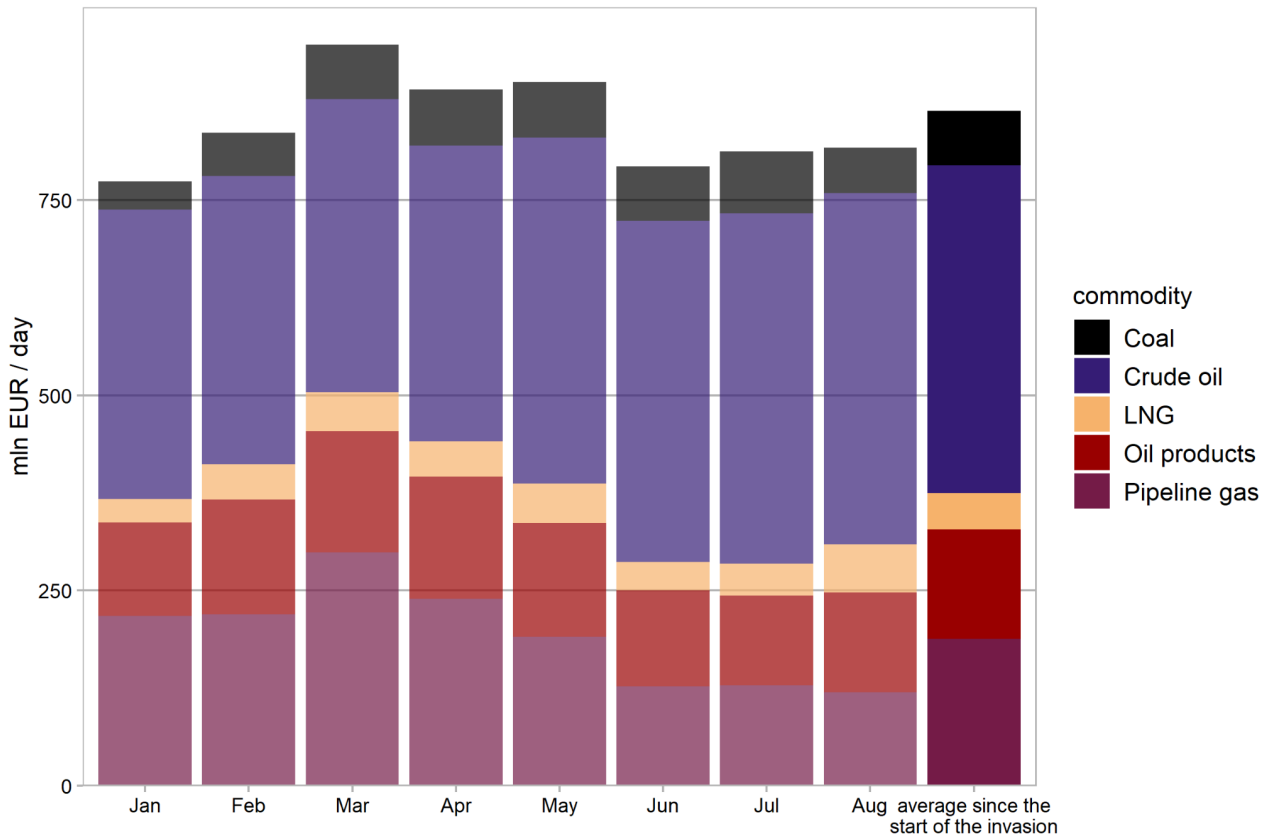
Fossil fuel exports are a key enabler of Russia's military buildup and brutal aggression against Ukraine. Oil and gas-related taxes and export tariffs account for more than 40% of Russia's federal budget annually. These revenues are also historically [correlated](#) with the country's regular military expenditure.

To shed light on who purchases Russia's oil, gas and coal, and how the volume and value of imports have changed since the start of the invasion, the Centre for Research on Energy and Clean Air has compiled a detailed dataset of pipeline and seaborne trade in Russian fossil fuels.

Figure 1 | Heat map of Russian fossil fuel shipment routes over 24 February - 24 August 2022



Russia's estimated revenue from fossil fuel exports



values are seasonally adjusted

Figure 2 | Russia's estimated revenue from fossil fuel exports since January 2022

Key findings

Fossil fuels continue to fill Kremlin's war chest, due to high prices

- Russia earned EUR 158 billion in revenue from fossil fuel exports in the first six months of the war (February 24 to August 24). The EU imported 54% of this, worth approximately EUR 85 billion.
- Fossil fuel exports have contributed approximately EUR 43 billion to Russia's federal budget since the start of the invasion, helping fund war crimes in Ukraine.
- The largest fossil fuel importer was the EU (EUR 85.1bn), followed by China (EUR34.9bn), Turkey (EUR10.7bn), India (EUR6.6bn), Japan (EUR2.5bn), Egypt (EUR2.3bn), and South Korea (EUR2bn).
- Within the EU, the largest importers were Germany (EUR19bn), Netherlands (EUR11.1bn), Italy (EUR8.6bn), Poland (EUR7.4bn), France (EUR5.5bn), Bulgaria (EUR5.2bn), Belgium (EUR4.5bn), and Spain (EUR3.3bn).
- India, China, the United Arab Emirates, Egypt, and Turkey saw the largest increases in imports, all driven by crude oil imports, with China also increasing coal imports.
- Surging fossil fuel prices mean that Russia's current revenue is far above previous years' level, despite the reductions in this year's export volumes.

Russia's export revenues inched up in July-August due to a rebound in crude oil

- In August, Russia's fossil fuel export revenues and volumes rebounded slightly from the low reached in June. Crude oil imports to the EU increased in July-August, compared with June. The other contributors to the rebound were crude oil imports to the United Arab Emirates, and LNG and coal imports to China, where thermal power generation increased due to droughts and heat waves.
- Russia's exports were however down 18% compared with the record level reached at the start of the invasion (February–March). The fall was driven by reductions in

exports of pipeline gas, oil products, and coal. Only the exports of crude oil increased compared with the period before the invasion.

- Compared with the start of the invasion, the reductions in imports of Russian fossil fuels cost the country EUR 170 million per day in lost revenue in July and August. The overall fall in export volumes was driven by a drop in exports to the EU which fell by 35%.
- Only a small fraction of the coming impact of the EU ban on Russian oil has been realised. The EU's oil imports from Russia fell 17% in July–August, compared with the level at the start of the invasion, but are set to fall by 90% around the turn of the year when the ban takes effect.

EU's import ban hit Russia's coal exports and production

- After the EU coal ban entered into force on August 10, Russia's coal export volumes fell to the lowest level since the start of the invasion. Russia failed to find other buyers to replace falling EU demand, despite the ban having been public knowledge for months. In the weeks after the coal ban, there have been no notable increases in shipments to any other countries or regions.

Capping Russia's export prices: Europe has the tools

- Out of ship capacity carrying Russian fossil fuels in July, 62% was owned by EU shipping companies and 73% was insured in the UK and Norway. Europe has the leverage to implement a price cap on Russia's oil exports that would effectively slash revenues.
- Russia is finding ways to reroute oil supplies: refining crude oil in third countries for re-export, blending with non-Russian oil, and using ship-to-ship transfers to obfuscate the origin of the oil. Stronger rules and enforcement are needed to prevent crude oil and oil products containing Russian oil from entering markets with bans in place.

How Europe is replacing imports from Russia

- Reducing the consumption of fossil fuels plays a key role in managing the impacts of Russia's export cuts and EU's import bans. Europe has reduced gas consumption in response to the high prices, but oil and coal consumption have increased. CO₂ emissions likely increased in the first half of the year, but as the reductions in gas consumption accelerate, CO₂ emissions have likely started to fall.
- The EU's total gas imports increased in the first half of the year, despite high prices, lower consumption, and Russia's decisions to cut exports, as countries sought to replenish storage levels. LNG imports and pipeline imports from Norway were the main replacements of Russian supply. Gas imports started falling below 2021 levels in the summer, which should ease pressure on the international market.
- It is essential for Europe to accelerate energy saving measures, particularly targeting oil and gas consumption, and to accelerate the deployment of clean energy, heat pumps, electric vehicles, and other technology to replace Russian fossil fuels.

The energy crisis is accelerating clean energy around the world

- While the immediate impact of the crisis has been to drive up demand for non-Russian supplies of fossil fuels, the sky-high fuel prices are making clean energy investments attractive around the world and creating momentum for clean energy policies.
- 19 European governments have accelerated their clean energy targets in response to the COVID-19 pandemic, the gas crisis, and Russia's aggression. These strengthened targets will result in a 30% reduction in fossil fuel use in the power sector by 2030, compared with energy plans in place in 2019.
- In the U.S., the Inflation Reduction Act is projected to be the single most consequential piece of legislation on clean energy, leading to a projected 40% reduction in greenhouse gas emissions from 2005 to 2030.
- Wind and solar installations in China made new records in the first half of the year, putting the country on track to add 130–150 gigawatts of capacity this year.

Introduction

After six months of the Russian military's illegal, ruthless invasion in Ukraine, far too many war crimes and atrocities have taken place. The revenue from Russia's fossil fuel exports is the key enabler of Russia's military buildup and aggression. Russia's expenditure on the war is uncertain, but it is estimated to be [no less than EUR 0.5 billion](#) a day and therefore approaching EUR 100 billion in total. Meanwhile, damages caused by the Russian military to Ukraine's infrastructure during the war [increased to EUR 110 billion](#), and the projected cost of rebuilding destroyed Ukrainian assets is almost EUR 200 billion.

Before the invasion, the EU bought more than 60% of Russia's fossil fuel exports. In the last six months, however, the EU has significantly reduced its fossil imports from Russia.

While phasing out imports of Russian fossil fuels to the US, EU and others makes an impact, there is a lot more leverage these countries can deploy. The prices the EU pays for fossil gas imported from Russia are currently linked to the prices in Europe's internal gas market, which have more than tripled from last year. This means that even after gas imports from Russia fell by 70%, Russia's export revenues hardly budged. Breaking the link between the gas market prices and prices paid to Russia is therefore of paramount importance to reduce Russian export revenues.

In the case of oil, Russia's ability to reroute exports relies on the use of European-owned ships, insured in Norway and the UK.

As currently formulated, the oil import bans of the EU, US, and the UK leave too many loopholes for Russian oil. Stricter rules on blending, transshipments, and refining in third countries as well as full enforcement of these rules are required.

Decisions to phase out energy imports from Russia have a devastating impact on the country's longer-term economic outlook. There is so far no sign of other countries being willing to take the role of the EU as an importer and investor in the country's fossil fuel sector.

The energy crisis is already speeding up the transition to clean energy in Europe and across the globe. Faster, short-term action is however needed to see Europe through this winter or to slash Kremlin's revenue in time to affect the outcome of the war. With decisive

action, there is a way out of this crisis that results in freedom and territorial integrity for Ukraine, as well as lasting peace and a secure, clean energy supply for Europe.

Fossil fuels continue to fill Kremlin's war chest, due to high prices

- Russia earned EUR 158 billion in revenue from fossil fuel exports in the first six months of the war (February 24 to August 24). The EU imported 54% of this, worth approximately EUR 85 billion.
- After the EU, the largest fossil fuel importers were China (EUR34.9bn), Turkey (EUR10.7bn), India (EUR6.6bn), Japan (EUR2.5bn), Egypt (EUR2.3bn), and South Korea (EUR2bn).
- Within the EU, the largest importers were Germany (EUR19bn), Netherlands (EUR11.1bn), Italy (EUR8.6bn), Poland (EUR7.4bn), France (EUR5.5bn), Bulgaria (EUR5.2bn), Belgium (EUR4.5bn), and Spain (EUR3.3bn).
- Fossil fuel exports contributed an estimated EUR 43 billion into Russia's federal budget, helping fund war crimes in Ukraine. Russian military expenditures after six months are estimated at approximately EUR 100 billion, while Ukraine is [bearing costs](#) of damaged infrastructure of over EUR 110 billion.
- The revenue comprises an estimated EUR 76 billion for crude oil, EUR 35 billion for pipeline gas, EUR 26 billion for oil products, EUR 13 billion for coal, and EUR 9 billion for LNG.
- Combined, the EU, NATO, and G7 countries (effectively, the EU, Turkey, and Japan) imported 56% of Russia's fossil fuel exports in July-August. This is down from 75% before the invasion but remains substantial.
- Surging fossil fuel prices mean that Russia's current revenue is far above previous years' levels, despite reduced export volumes. The average prices of Russian fossil fuels are more than twice as high as they were in 2021. These revenues contribute directly to Russia's military budget. We estimate that at least EUR 43 billion has gone directly into the coffers of the Russian state from its mineral extraction tax and export duty since the beginning of the war.

- To address Russia’s short-term windfall caused by high fossil fuel prices, tariffs or price caps are needed. There is a particular need to decouple gas import prices from Russia from Europe’s internal gas prices.

Largest importers of fossil fuels from Russia

in the first six months of the invasion

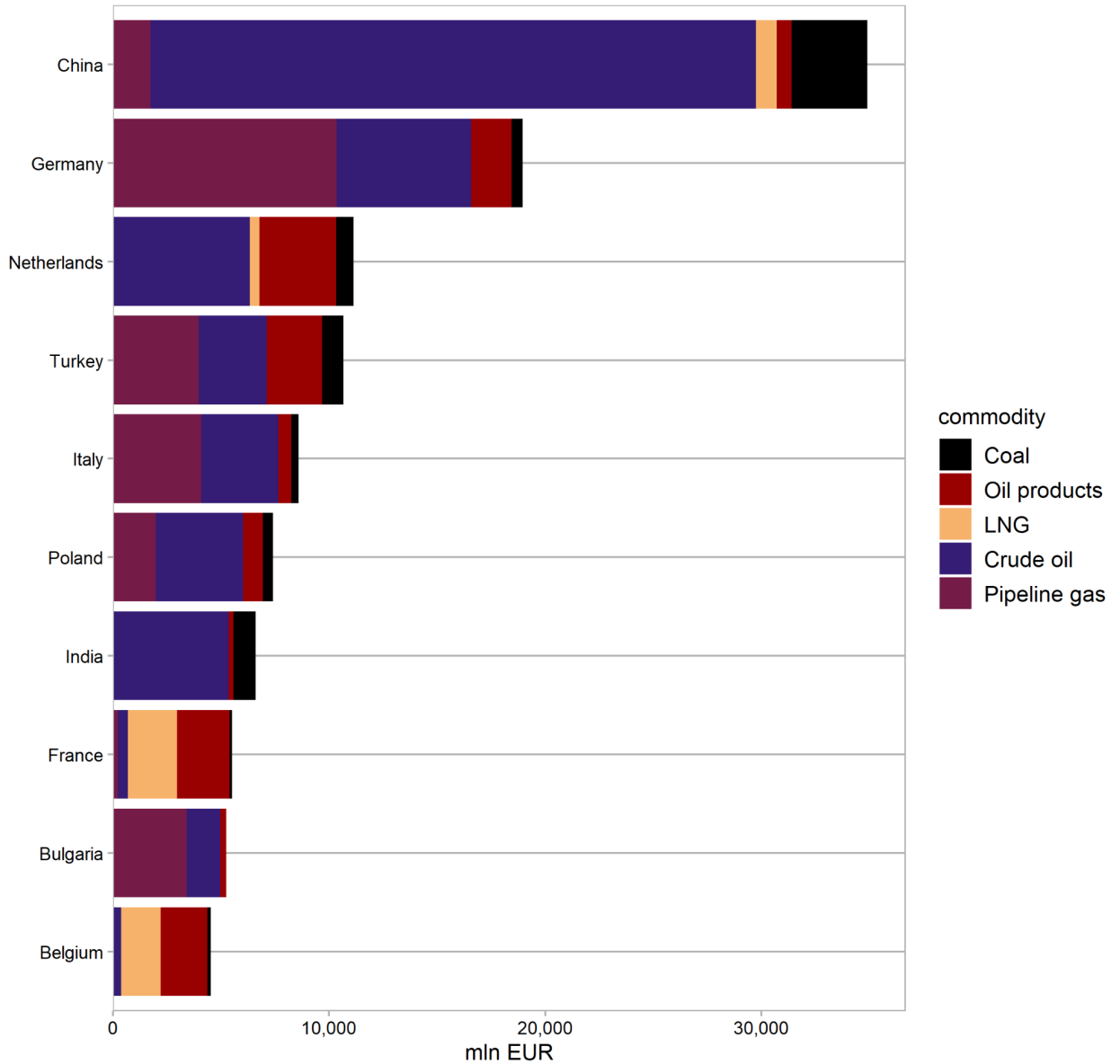


Figure 3 | Largest importers of fossil fuels from Russia

Russia's export revenues inched up in July-August due to a rebound in crude oil

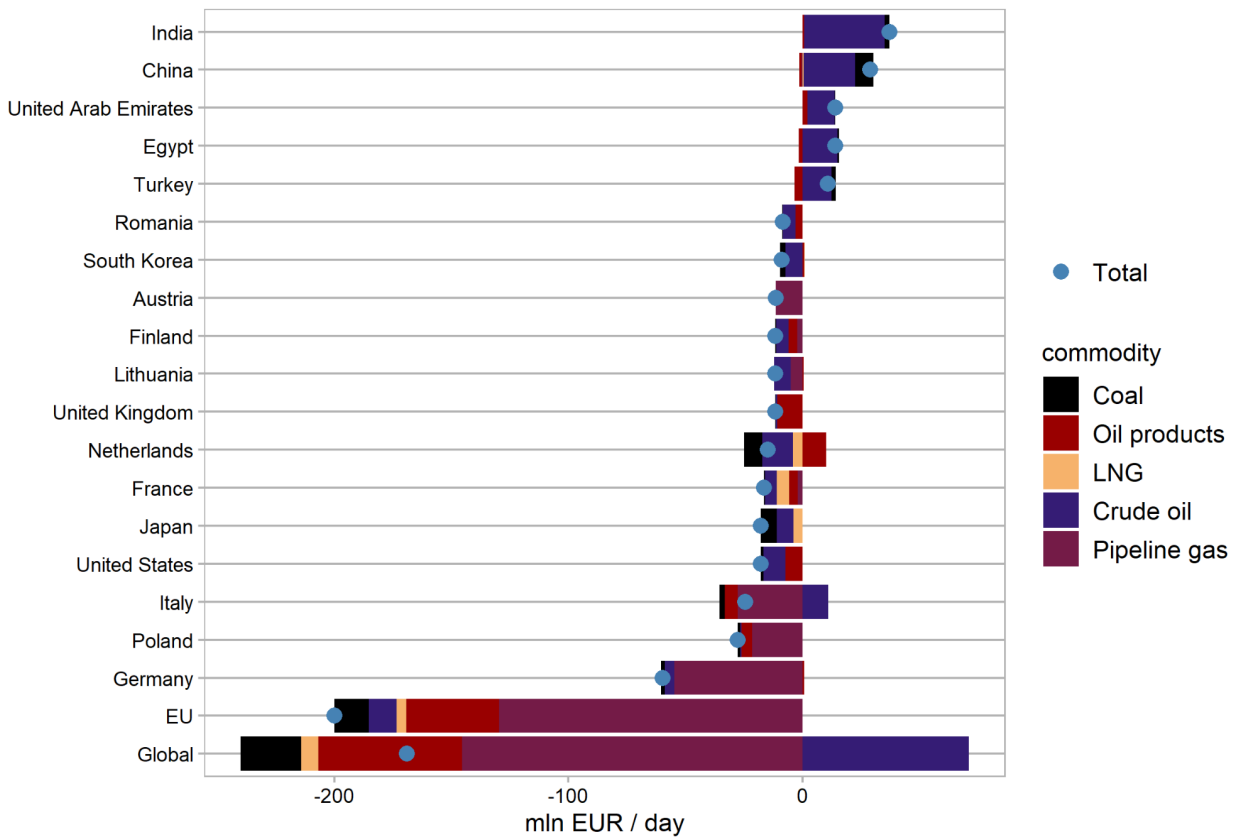
- In August, Russia's fossil fuel export revenues and volumes rebounded slightly from the low reached in June.
- Crude oil imports to the EU increased in July-August, compared with the low reached in June. The other contributors to the rebound were crude oil imports to the United Arab Emirates, and LNG and coal imports to China, where thermal power generation increased due to droughts and heat waves.
- Looking at the longer-term trend, exports were down compared with the record level reached at the start of the invasion. The value of exports fell by 18% in July-August, compared with February-March, on a seasonally adjusted basis.
- The fall was driven by reductions in exports of pipeline gas, oil products, and coal. Only the exports of crude oil increased compared with the period before the invasion. Exports of fossil gas through pipelines fell by 56%, coal by 29%, LNG by 15%, and oil products by 34%. Crude oil exports increased by 19%, for a 2% increase in total oil exports.
- The overall fall in export volumes was driven by a drop in exports to the EU, which fell by 35%.
- Compared with the start of the invasion, the reductions in imports of Russian fossil fuels cost the country EUR 170 million per day in lost revenue in July and August. The overall fall in export volumes was driven by a drop in exports to the EU which fell by 35%.
- Only a small fraction of the coming impact of the EU ban on Russian oil has been realized. The EU's oil imports from Russia fell 17% in July-August, compared with the level at the start of the invasion, but are set to fall by 90% around the turn of the year when the ban takes effect.
- The reductions in imports of Russian fossil fuels cost the country EUR 170 million per day in lost revenue in July and August, as imports into the EU, US, Japan, and the UK fell by EUR 250 mln/day.
- India, China, the United Arab Emirates, and Egypt saw the most significant increases in imports in July-August, compared with the start of the invasion. All of

the increases driven by crude oil imports, with China also increasing coal imports. Turkey’s swelling imports are notable as the country has professed support for Ukraine’s territorial integrity.

- Report by Russia’s Ministry of Finance [confirms](#) that monthly budget revenue fell year-on-year in July, for the first time this year. There was a shortfall in budget revenues of EUR 1.2 billion compared to planned revenue.

Changes in monthly import volumes from Russia

July-August 2022 compared to February-March 2022, seasonally adjusted



Values are seasonally adjusted and calculated at constant prices

Figure 4 | Changes in monthly import volumes from Russia

A handful of countries have increased crude oil imports

- China has overtaken Germany as the largest importer of fossil fuels from Russia, as Germany's imports have fallen and China's have increased by 17% in July–August, compared with the level at the start of the invasion. There is however limited headroom for further increases, as China is already buying essentially everything that Russia can supply to the Pacific market. This implies that importing substantially more would require either very long and costly shipments from Russia's western ports, or building new infrastructure which would take years.
- India's oil imports from Russia have remained high at about 40 million EUR/day since surging in May. The country imported almost no oil from Russia before the start of the invasion. Approximately half of the oil products shipped out of the main refineries receiving Russian oil are re-exported to other countries, including the US and Australia, which have banned the imports of Russian oil.
- Egypt has emerged as a significant buyer, with imports peaking at 50 kt/day, or 30 mln EUR/day in July, up from almost zero before the invasion. Similar to India, Russian oil exported to Egypt is often re-exported elsewhere. There have also been concerns that Russian and Egyptian oil barrels could be blended, providing an outlet for Russian oil. An expansion of El Hamra oil terminal, one of the destinations for Russian oil, has been [announced in August](#).
- The United Arab Emirates has increased its imports of Russian oil to 30 million EUR/day (20 kt/day) in August, from essentially no imports before the invasion. UAE has emerged as a trading post for Russian crude and refined products as it does not take part in sanctions against Russia and has an extensive network of trading [companies](#) willing to take Russian oil products using non-dollar-denominated transactions.

- Turkey’s oil imports from Russia increased 30% in July–August, compared with pre-invasion levels. The country is a member of NATO but has refused to join sanctions against Russia.

Fossil fuel exports from Russia

Value of exports by destination and fuel

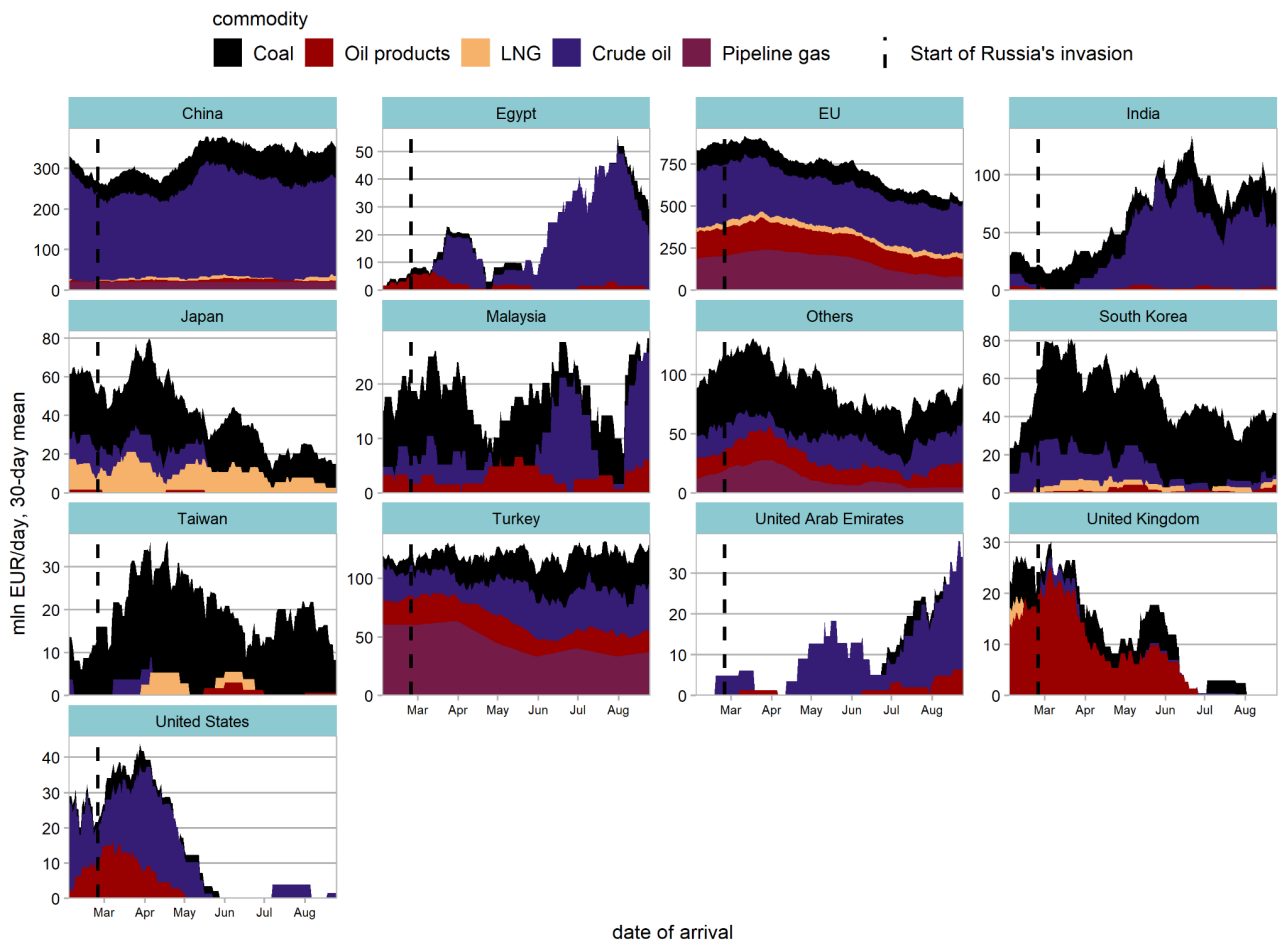


Figure 5 | Fossil fuel exports from Russia

EU import ban hits Russia's coal production and trade

- After the EU coal ban entered into force on August 10, Russia's coal export volumes fell to the lowest level since the start of the invasion. Russia failed to find other buyers to replace demand from the EU, although the ban has been public knowledge for months. In the weeks after the coal ban, there have been no notable increases in shipment to any other country.
- In the two months before the coal ban, the EU still imported 20% of Russia's coal exports, with the Netherlands, Poland, Germany, Spain, and Italy the largest importers.
- The fall in coal exports is [leading](#) to mine closures in Russia's main coal-producing region, Kemerovo.
- Starting from August 29, imports and trade of Russian coal are also banned in Switzerland. This has a major impact on the industry, as around three-quarters of Russian-origin coal exports were [traded in Switzerland](#). Some Swiss-based trading companies are already [reported](#) to be creating subsidiaries and moving operations to other countries, such as the U.A.E.

Russia's coal exports take a hit

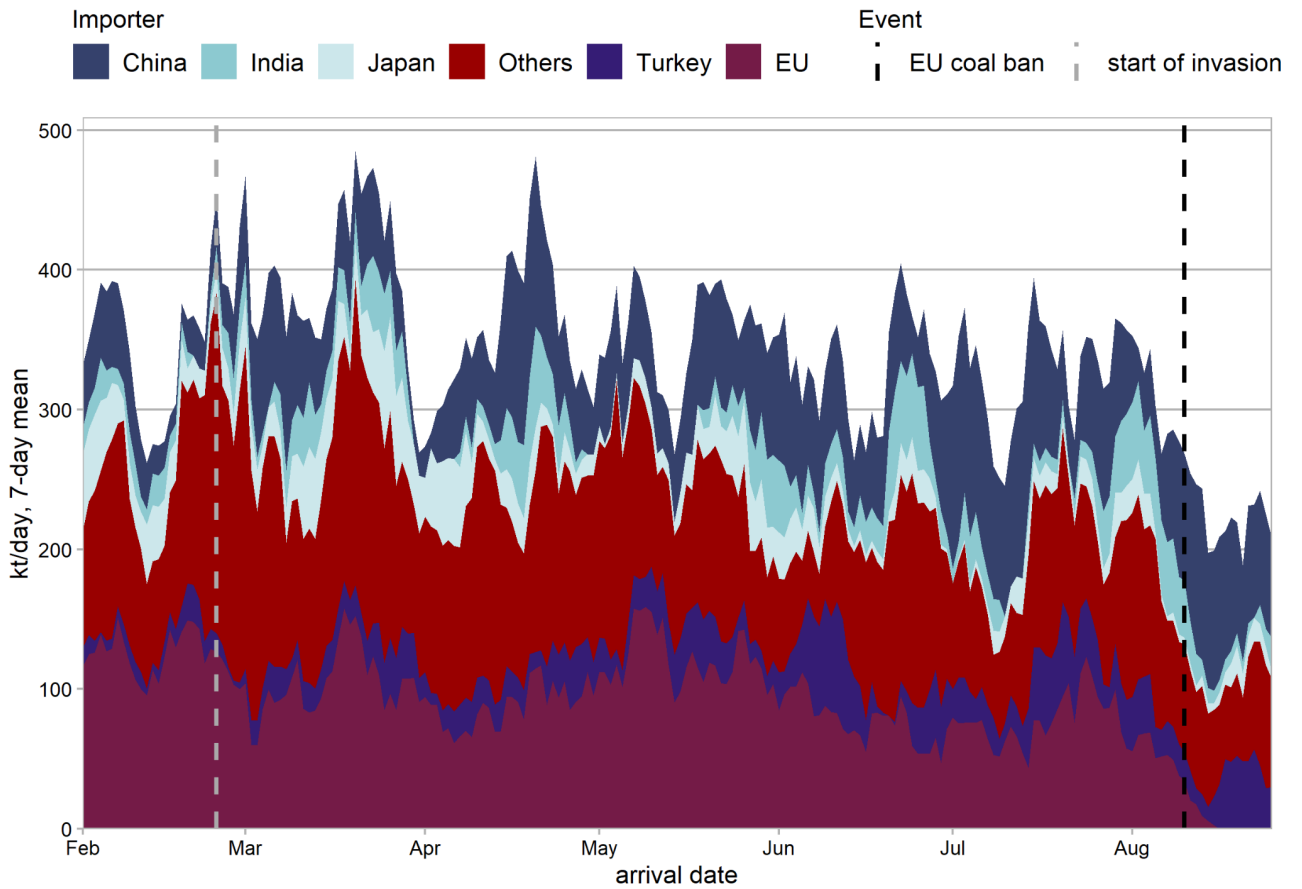


Figure 6 | Russia's coal exports take a hit

Capping Russia's export prices: Europe has the tools

- In July, 62% of all ship capacity loaded with Russian fossil fuels was owned by EU companies. The vast majority of ships carrying Russian fossil fuels are insured in the UK (51%) and Norway (22%). Therefore, Europe has the leverage to implement a price cap on Russia's oil exports that would effectively slash revenues.
- The increase in shipments of Russian oil to India, the Middle East, and Egypt is being enabled by European-owned and insured ships, which carry most of the oil.
- The US and Australia have continued to receive shipments of oil products from refineries in India that are among the largest buyers of Russian oil. The EU will likely face the same issue when the oil ban enters into force in December.
- A blend of Kazakh and Russian oil is being exported to the UK, and unless the rules on blended oil are strengthened, these imports [could continue](#) into 2023, even as the UK's oil ban enters into force.
- Other loopholes such as transshipments of oil through EU ports, as [happened](#) recently in Estonia, need to be addressed as well.
- Countries that are banning Russian oil imports need to build strong enforcement mechanisms and rules to prevent inflows of oil through indirect routes, and to prevent their shipping and insurance industries from enabling Russia's exports elsewhere.

EU-owned ships carry most Russian fossil fuel shipments

Average ship capacity loaded with Russian fossil fuels in July, by country of ship owner

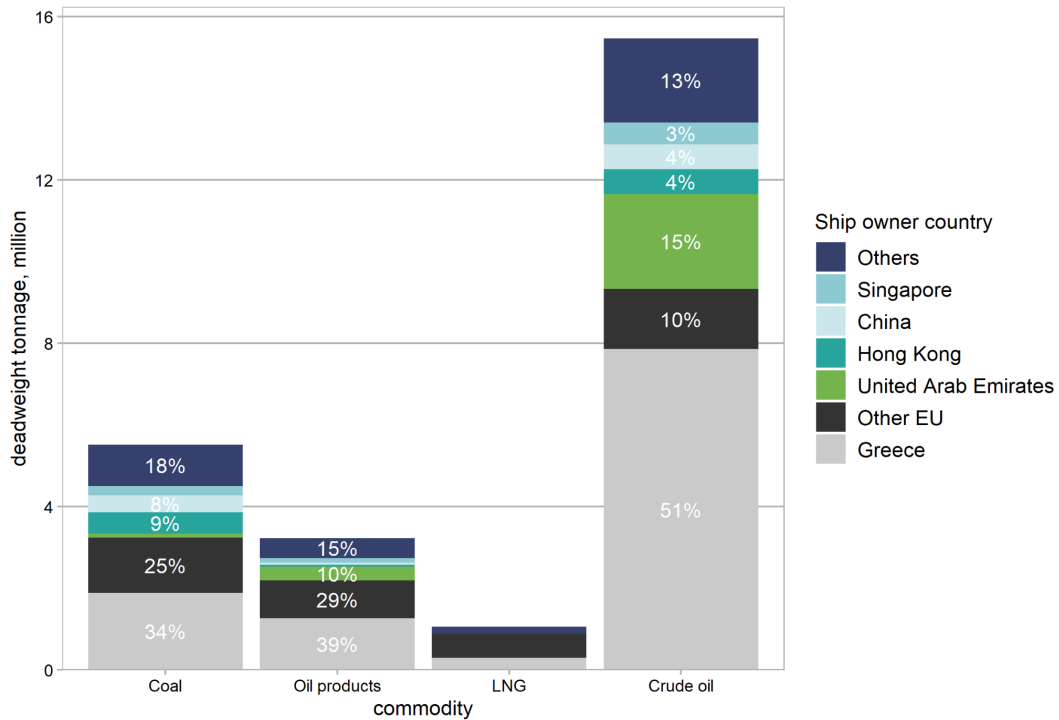


Figure 7 | Incorporation country of ship insurers

UK and Norway insurers cover most Russian fossil fuel shipments

Average ship capacity loaded with Russian fossil fuels in July, by country of insurer

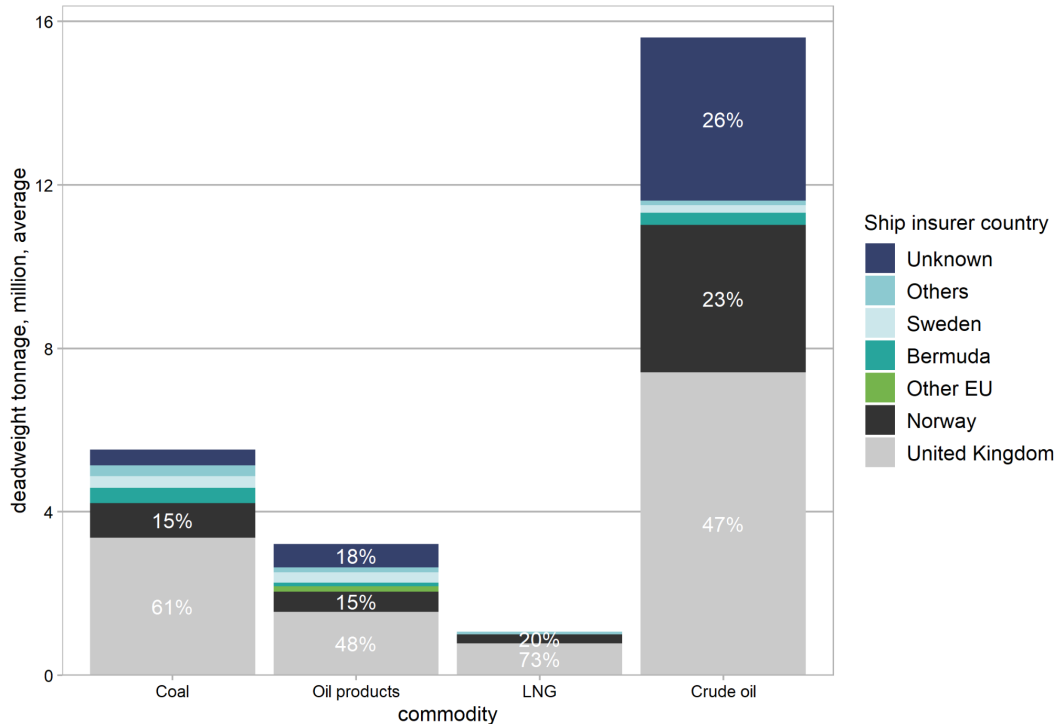


Figure 8 | Incorporation country of ship owners

How Europe is replacing imports from Russia

- Reducing the consumption of fossil fuels plays a key role in managing the impacts of Russia's export cuts and EU import bans. Europe has reduced its gas consumption, however, oil and coal consumption have increased. CO₂ emissions likely increased by approximately 2% in the first half of the year, as an 11% drop in gas consumption was counterbalanced by an increase in the consumption of oil products (8%), hard coal (7%), and lignite (12%) based on Eurostat data. However, with a sharp, 20% drop in gas consumption in the summer, CO₂ emissions have likely started to fall in August.
- In the power sector, drops in French and German nuclear output and Mediterranean hydropower output have driven an increase in power generation from both gas and coal. Wind and solar generation have increased but the increases haven't been large enough to offset the fall in nuclear and hydro in the short term.
- As oil and coal consumption in Europe have increased while imports from Russia contracted, imports from other sources have shot up. South Africa has become a major coal provider to Europe. For example, coal shipments to Europe from the [Richards Bay Coal Terminal](#) (RBCT) from the beginning of January to the end of May, were up [40%](#) in January–May. Buyers include the Netherlands, Italy, France, Spain, Denmark, Poland and Germany. Other exporting countries include [Colombia and Australia](#). A jump in imports from Russia in the spring, after the coal ban was agreed in early April, indicates that European utilities stocked up on Russian coal. This also softened the impact of the ban.
- Total daily oil flows from the Middle East — led by Saudi Arabia and Iraq — to Europe shot up by 90% in July compared to January 2022. US crude oil exports to Europe are simultaneously at record highs.
- The EU's total gas imports increased in the first half of the year despite high prices, comparatively low consumption, and Russia's decisions to cut exports, as countries sought to replenish storage levels. LNG imports and pipeline imports from Norway made up for the cutback in Russian supply. Gas imports started falling below 2021 levels in the summer, which should ease pressure on the international market.

Russia's gas blackmail

- Russia has dramatically cut gas flows to Europe, except Turkey, by three fourths since the first half of 2021, in violation of existing contracts.
- Pipeline gas supplies are the hardest fossil fuels imports to replace in the short run and the most consequential in stoking inflation on the continent due to their link with European [power](#) markets.
- [Gas](#) prices in Europe in August have reached levels 13 times as high as those last year, reflected almost instantly in [power](#) price increases.
- Russia is exploiting not only Europe's outsize reliance on Russian gas, but also the price formation mechanisms on the gas and power markets, to blackmail Europe while gaining outsize revenues. Case in point: Gazprom is making as much money selling gas to the EU now, as it did in the first half of 2021, while delivering a fraction of the gas.
- To protect European consumers from wild price swings, power price [shock](#) absorbers or even complete overhauling of the system are on the [table](#), as winter approaches and gas plays an even more significant role in power generation.
- Tweaks or reforms to the market must ensure that Russia's ill-gotten windfall from its own market manipulation is eliminated.
- To combat fuel price increases and cut Russia's export revenues, the EU must accelerate energy-saving measures, particularly targeting oil and gas consumption, and accelerate the deployment of clean energy, heat pumps, electric vehicles, and other technologies that can replace Russian fossil fuels.

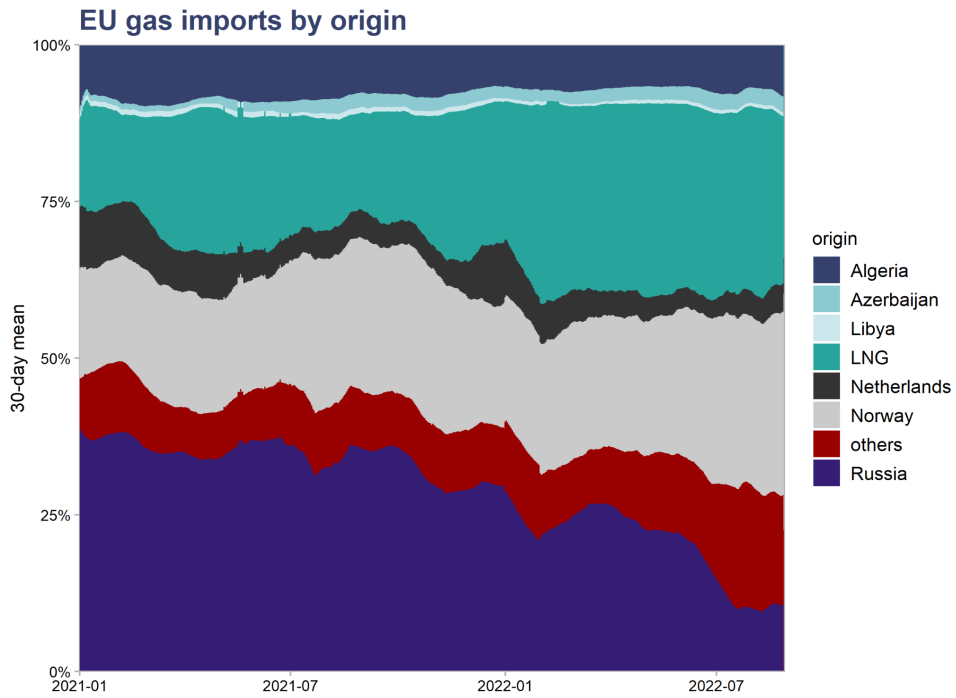


Figure 9 | EU gas imports by origin

Fossil gas exports from Russia to the EU

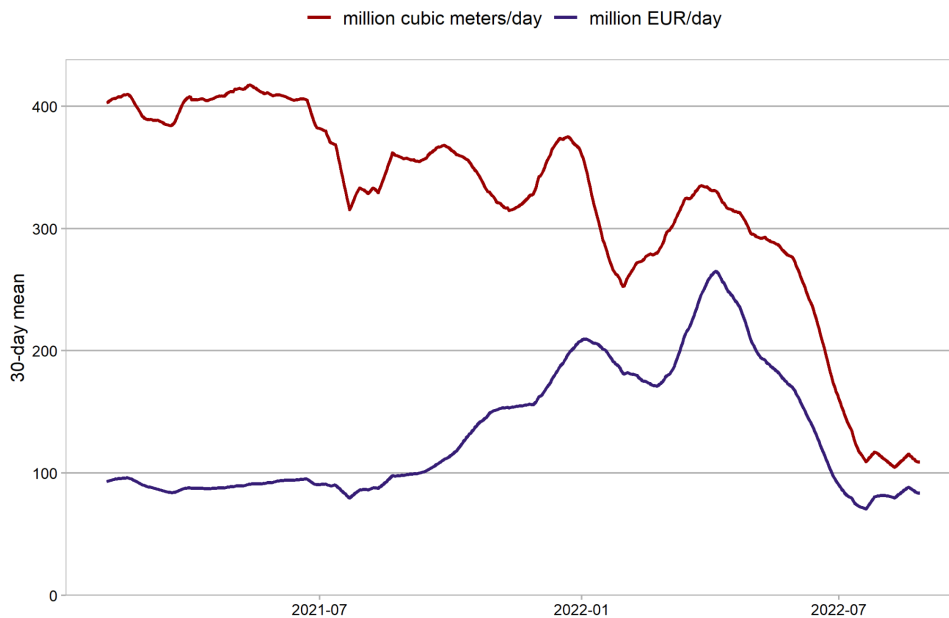


Figure 10 | The EU continues to pay as much to Russia for gas as it did in the first half of 2021, while receiving a fraction of the gas.

EU Gas imports, storage and implied consumption

Billion cubic meter per day



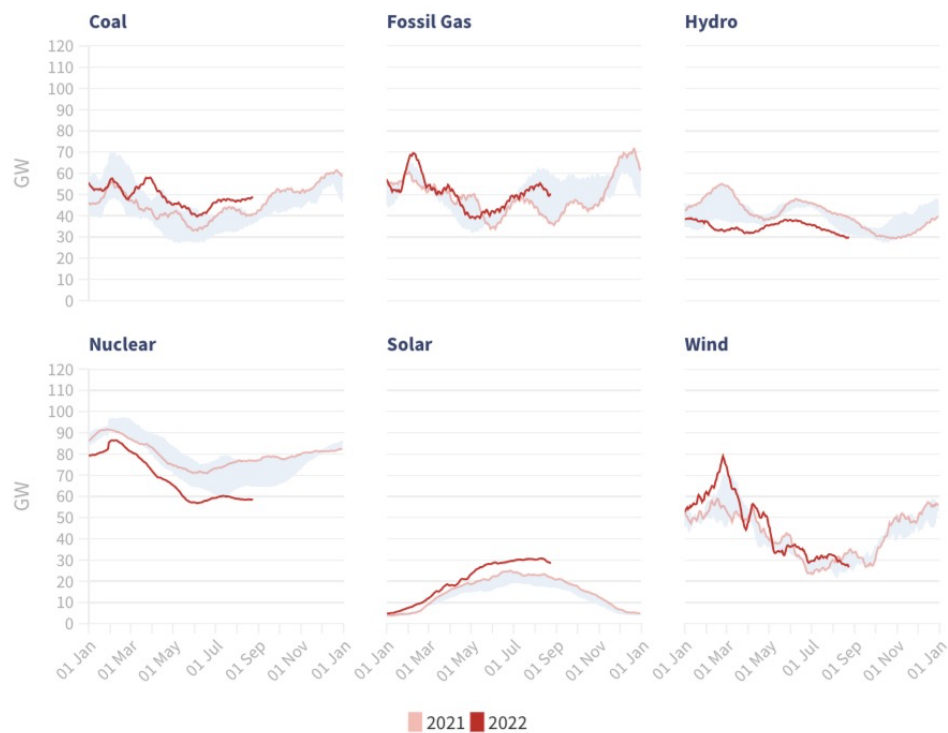
Source: CREA analysis based on ENTSOG



Figure 11 | EU gas imports, storage, production and implied consumption

EU Power Generation

30-day running average



Source: [ENTSOG](#) • The light blue area represents boundaries for 2016-2021.



Figure 12 | Trends in EU Power generation mix

The energy crisis is accelerating clean energy deployment around the world

- Sky-high fossil fuel prices are making clean energy investments attractive around the world and creating new momentum for clean energy policies.
- 19 European governments have accelerated their clean energy targets in response to the COVID-19 pandemic, the gas crisis, and Russia's aggression. These strengthened targets will result in a 30% reduction in fossil fuel use in the power sector by 2030, compared with energy plans in place in 2019.
- Most new policies and policy announcements have focused on the power sector. However, Europe's greatest vulnerability is gas use in buildings, where action needs to be strengthened. Nevertheless, several European countries have already introduced funding and grants for retrofitting heat pumps and insulation: A subsidy scheme in [France](#) will encourage households to switch to renewable heating systems, while [Italian subsidies](#) aim at increasing energy efficiency in old and poorly constructed buildings. The Dutch plan will result in [insulating 2.5 million homes](#) in the country. In the UK, the [British energy security strategy](#) introduces a target of installing 600,000 heat pumps per year by 2028. [Canada](#) has also introduced a support scheme for housing retrofits.
- The US Inflation Reduction Act is projected to be the single most consequential piece of legislation on clean energy, introducing strong incentives for clean power generation, electric vehicles, and energy-efficient appliances. All these measures will help replace fossil fuels, leading to a projected 40% reduction in greenhouse gas emissions from 2005 to 2030.
- Wind and solar installations in China made new records in the first half of the year, putting the country on track to add 130–150 gigawatts of capacity this year.

In our [briefing](#) published in June, we looked at the new clean energy targets and policies in the EU, focusing mostly on the power sector.

Policy recommendations

As progress has been made in reducing the volume of Russian fossil fuel imports, high prices have emerged as the main issue. Currently, high prices rather than active policy measures are the main tool being used to manage the shortfall in fossil fuel supply. This approach hurts consumers and the economy, while generating vast revenue for the Kremlin. This situation arises because the prices paid to Russia are linked to the prices on the European internal market. These prices are currently being pushed upwards by buyers trying to outbid each other in a situation of scarcity. The result is the current situation where each euro buys comparatively little energy, and comparatively lot of war.

There are, however, multiple tools that can be used to solve this problem:

- Decouple prices paid to Russia from internal energy prices, using either price caps on the wholesale markets where gas and oil imported from Russia are traded, or high import tariffs on Russian fuels. Tariffs would not raise prices for European consumers as Russian fossil fuel production and exports would remain profitable at significantly lower prices than experienced today. In the case of price caps, separate, uncapped markets would need to be created for non-Russian fuels.
- The measures to decouple Russia's export prices from global market prices should also extend to Russia's exports to third countries. This would take the form of either setting price caps on shipments carried out using European flagged or insured ships, or levying high taxes on such shipments (e.g. using the existing tonnage taxation system).
- Implement short-term energy-saving measures. These could include lowering indoor temperatures in public buildings, offering cash incentives to consumers to reduce consumption, and rationing gas to industrial users (rather than using prices to do that).
- To address the cost-of-living crisis, governments should support the incomes of vulnerable groups, instead of supporting fossil fuel consumption directly through subsidies or price caps, which simply drives European prices up further and/or risks physical shortages.
- To get out of the trap for good, the EU must accelerate energy-saving measures, particularly targeting oil and gas consumption, and accelerate the deployment of clean energy, heat pumps, electric vehicles, and other technologies that can replace Russian fossil fuels.

CREA encourages all governments and corporate buyers of Russian fossil fuels to create a plan to replace these fuels with clean (non-fossil) energy, energy efficiency, and energy savings measures as soon as possible. This will be far more impactful than just re-arranging the global trade flows of fossil fuels, and will have far greater economic, health, and national security benefits.

Methodology

Seaborne shipments

We track ship voyages between Russian ports and ports in other countries using data from MarineTraffic.com and Datalastic, derived from ship location and operation (AIS) data.

A voyage consists of a ship taking on cargo and departing from a Russian port, arriving in a non-Russian port, and discharging cargo. More complex trips such as loading cargo from both a Russian and a non-Russian port are excluded. For crude oil tankers and LNG tankers, the type of cargo is known. We assume that oil product tankers and oil/chemical tankers carry oil products. Coal is transported by bulk carrier and general cargo ships which also carry many other types of cargo. We identified 25 “coal export terminals” within Russian ports that export coal. These are specific port locations that are associated with loading coal. When a vessel takes on cargo at one of these locations, we assume that the shipment is a coal shipment.

The amount of fuel transported in a shipment is estimated based on the cargo capacity (deadweight tonnage) of the ships, adjusted by the average ratio of ship capacity to reported customs volume. We validated this approach by aggregating the cargo capacity of shipments in the latest month with complete trade data (December 2021), and comparing these values to reported export volumes.

Trade volumes and pricing of fossil fuels (i.e. oil, coal, and gas) are often not available on hourly or daily basis, and neither are the terms for long-term contracts. To develop this counter, we therefore relied on some assumptions, as detailed below.

Ship-to-ship (STS) transfers

We collect information about STS events occurring between ships using MarineTraffic.com, which [uses vessel position and speed for detection](#). We attempt to verify these transfers by then using Datalastic to query the positions of the interacting vessels at the time of the

transfer, and calculating the distance between them, though this is not always possible and dependent on AIS data being available.

In case several vessels transfer cargo into or out of a single vessel, to determine the split of cargo parent and child vessels, we split the deadweight tonnage (DWT) of the parent between the children based on their proportional DWT. After a STS transfer has been detected, we follow the logic outlined above and look for a discharge at a non-Russian port of the receiving vessel. Hence, a voyage in these situations consists of a different departing and arriving ships.

Other physical flows

For Europe, including Turkey, two main sources are being used for the following flows:

	Crude oil	Oil products	Fossil gas	Coal
Pipeline	Eurostat	Eurostat	ENTSOG	Eurostat
Seaborne	AIS data	AIS data	AIS data	AIS data

ENTSOG data is available on a daily and near real-time basis.

Eurostat data, however, is only available on a monthly basis till the end of 2021. To derive 2022 trade flows, we scale 2021 trade flows using y-o-y ratios in November-December 2021. Oil pipeline flows to the EU and China and gas pipeline flows to China are assumed to continue at 2021 levels. China's pipeline import flows are based on the latest figures given in news reports for winter 2021–22.

Attribution of pipelined gas to individual countries

We have implemented a [new methodology](#) to estimate pipeline gas imports from Russia to various European countries. We collect data from ENTSOG on flows between countries, at transmission interconnections for every single day. We then assume that on any given day, a country is a perfect 'gas mixer', that is, that all gas gets mixed before being consumed and/or re-exported. This allows us to attribute Russian gas consumption to countries that do not have direct connection with Russia.

There is no one “correct” way to attribute gas imports by country. The European gas market allows physical flows to be disconnected from the trades taking place. Even countries that have no physical net flows from Russia, such as Spain, can and do purchase from Gazprom. However, given the lack of transparency on transactions, tracking the physical flows is the best way we have of approximating where Russian gas ends up in Europe.

This assumption means that any country’s export on a specific day is composed in equal proportion to its imports that day.

We treat seaborne LNG imports as one exporter and remove the consumption of LNG from the totals, as we track LNG shipments separately as a part of our shipment tracking.

We only look at net inflows and outflows into a country, without explicitly accounting for gas storage. Storage shifts consumption over time, but for importing countries, storage has to be replenished from imports, so this assumption should not affect the mix of the sources of importing countries’ consumption over a longer period of time.

Pricing

Fossil fuels are sold on a variety of contracts including fixed-price, indexed to average oil prices, and indexed to other spot prices. This means that the revenue to the exporter is not directly proportional to the current spot price.

To estimate the prices of fossil fuel trades in 2022, we first derive historical monthly average prices for imports from Russia to the EU from Eurostat, and to the rest of the world from UN COMTRADE, since the trade values are indicated both in physical and monetary terms. We then fit models between these historical prices and average monthly spot prices for the current month and with lags (Brent crude oil, TTF gas, Newcastle steam coal, Asian LNG, ARA coal). Models are built for main trading partners individually, and for the rest of the world as a whole.

After the start of the invasion, the reluctance of many traders to take cargoes from Russia has driven discounted pricing of Russian oil. We apply the discount between Brent and Urals crude prices to crude oil exports to Europe and the discount between Brent and ESPO to exports to Asia.

Oil-indexed gas contracts have become less common over time, so we include a time interaction term in the model for pipeline gas prices. These models are then applied to current spot prices to estimate contract prices.

Seasonal adjustments

Much of the data reported in this report is seasonally adjusted, in order to discern changes in import volumes that are not driven by normal seasonal variation. To do this, we developed monthly correction factors for each country-commodity pair using UN COMTRADE and Eurostat monthly trade data, as well as daily pipeline gas data from ENTSOG. We calculated daily average imports from Russia for each month of the year in 2018–2021, and divided the value by the average for the whole period to obtain the ratio of imports during each month to the annual average. The import volumes during the analysis period were divided by these month-specific ratios to perform the seasonal adjustment. Countries that didn't have imports during all months of the year, or that had very small shipment volumes were aggregated together into the categories "Other EU countries" and "Other countries" category.

The trends reported at "constant prices" are calculated by taking the average price for each importing country-commodity pair over the analyzed period, and applying that price to the physical volumes. This shows the effect of changes in import volumes on Russia's export revenue, while weighing each fuel by its average price.

Seasonality is significant for pipeline gas, LNG, and coal imports for most countries, somewhat significant for oil products, and almost negligible for crude oil. None of the central findings of the report are dependent on whether the season adjustment is performed.

References:

- Eurostat: <https://ec.europa.eu/eurostat/databrowser/>
- ENTSOG transparency platform: <https://transparency.entsog.eu/>
- UN COMTRADE: <https://comtrade.un.org/Data/>



About CREA

Centre for Research on Energy and Clean Air (CREA) is an independent research organization focused on revealing the trends, causes, and health impacts, as well as the solutions to air pollution. CREA uses scientific data, research, and evidence to support the efforts of governments, companies, and campaigning organizations worldwide in their efforts to move towards clean energy and clean air, believing that effective research and communication are the key to successful policies, investment decisions, and advocacy efforts. CREA was founded in December 2019 in Helsinki and has staff in several Asian and European countries. Our work is funded through philanthropic grants and revenue from commissioned research.

In our [statement of support](#) for Ukraine, CREA absolutely condemns the Russian military's unprovoked and unjustified attack against another sovereign nation, Ukraine. The assault goes against the fundamental values of human well-being, safety, and dignity that our organization seeks to advance. We urgently call for an end to the assault and stand in solidarity with the Ukrainian and Russian people calling for peace.