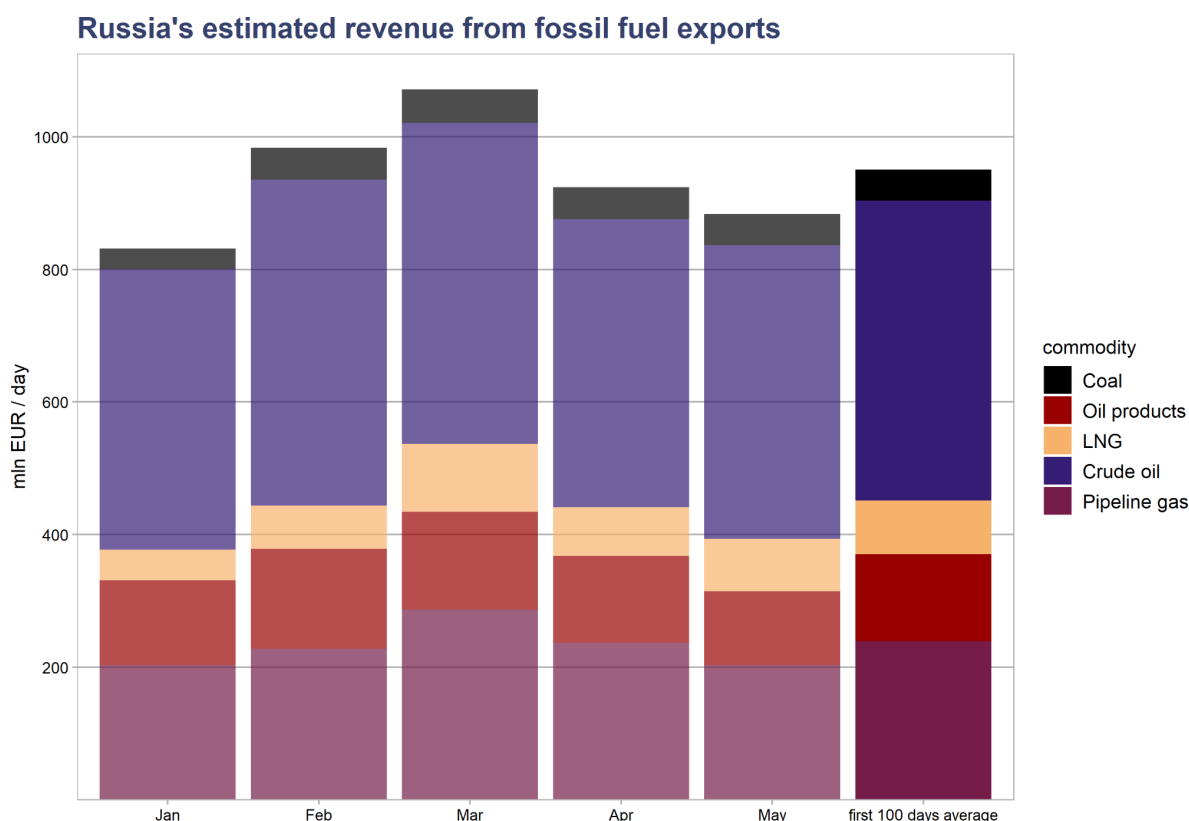


Financing Putin's war on Europe: Fossil fuel imports from Russia in the first 100 days of the invasion

Fossil fuel exports are a key enabler of Russia's military buildup and brutal aggression against Ukraine.

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.



Key findings

Fossil fuels are filling Kremlin's war chest

- Russia earned EUR 93 billion in revenue from fossil fuel exports in the first 100 days of the war (February 24 to June 3). The EU imported 61% of this, worth approximately 57 billion EUR.
- The largest importers were China (EUR12.6bln), Germany (EUR12.1bln), Italy (EUR7.8bln), Netherlands (EUR7.8bln), Turkey (EUR6.7bln), Poland (EUR4.4bln), France (EUR4.3bln) and India (EUR3.4bln).
- The revenue comprises an estimated EUR46bln for crude oil, EUR24bln for pipeline gas, EUR13bln for oil products, EUR5.1bln for LNG and EUR4.8bln for coal.

Russia's export revenues have been falling since March, but remain record-high

- Import volumes fell modestly in May, around 15% compared with the time before the invasion, as many countries and firms shunned Russian supplies. The reduction in demand and the discounted price for Russian oil cost the country approximately 200 million EUR per day in May. However, increase in fossil demand has created a windfall: Russia's average export prices were an average 60% higher than last year, even if they were discounted from international prices.
- China overtook Germany as the largest importer. China's imports have been essentially constant while Germany has managed a modest reduction in oil imports from Russia.
- Poland and the United States made the largest dents in Russia's revenue. Lithuania, Finland and Estonia achieved sharp percentage reductions of more than 50%.
- The record-high fossil fuel prices and the drive to reduce reliance on Russia have prompted increased ambition for clean energy and energy efficiency across Europe, which will effectively lessen the impact of banning imports from Russia. Spreading the most effective national policies across the bloc and beyond could substantially increase the impact.

India, Middle East, France and Belgium are dipping into discounted Russian fuels

- India, France, China, United Arab Emirates and Saudi Arabia increased imports.
- India became a significant importer of Russian crude oil, buying 18% of the country's exports. A significant share of the crude is re-exported as refined oil products, including to the U.S. and Europe, an important loophole to close.
- European buyers, in France, Belgium and the Netherlands, bought most of the short-term cargoes at a discount, buying LNG and crude oil on the spot market. These purchases take place outside of pre-existing contracts, hence always representing an active purchase decision.

Most Russian fossil fuel is transported on European ships

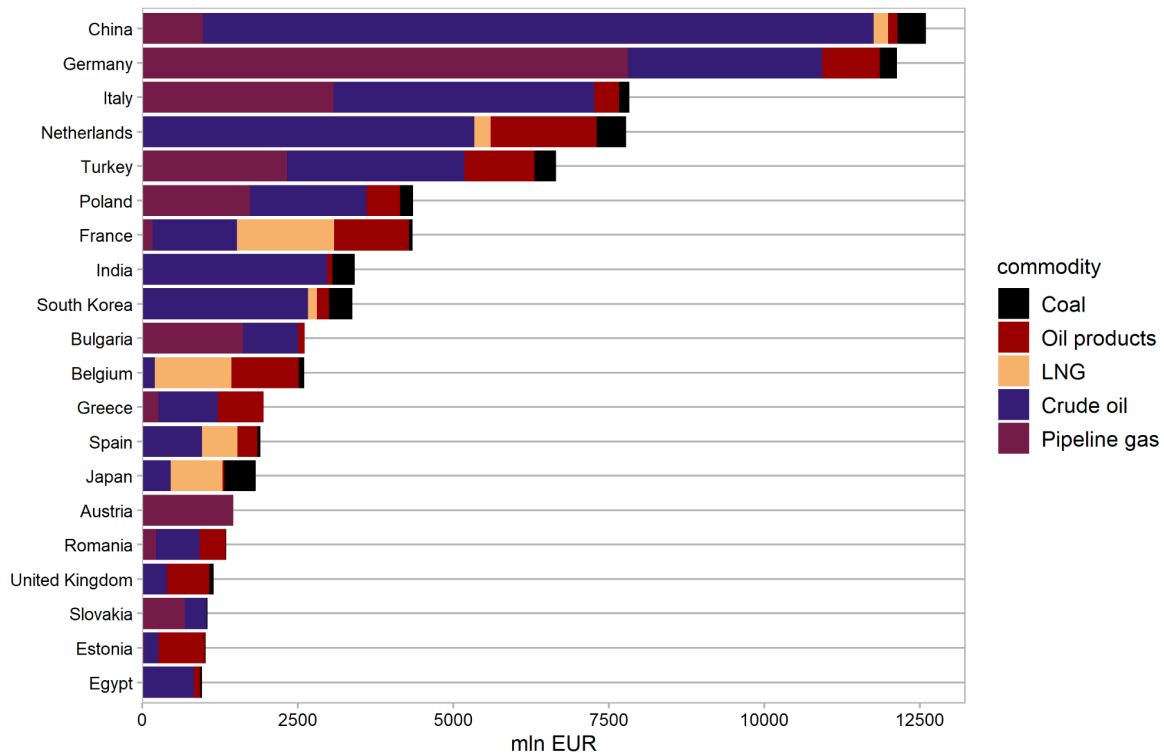
- As Russian oil is increasingly shipped to more distant markets, more tanker capacity than ever before is needed. This is a key vulnerability — strong sanctions against tankers transporting Russian crude would significantly limit the scope for this kind of rerouting of Russia's exports. In April-May, 68% of deliveries of Russian crude oil were made with ships owned by EU, UK and Norwegian companies, with Greek tankers alone carrying 43%. For deliveries to India and the Middle East, the share was even higher at 80%. 97% of the tankers were insured in just three countries, UK, Norway and Sweden.

13 oil, power and industrial firms continued purchases in May while others might be exiting

- In our previous analysis, we identified 23 large companies that bought Russian fossil fuels in the first two months of the war. 13 of these have continued purchases in May: oil companies Exxon, Shell, Total, Repsol, Lukoil, Neste, and Orlen; power utility companies Taipower, Chubu Electric Power, TEPCO and Trieste thermal power plant; and industrial companies Nippon Steel, POSCO, Formosa Petrochemical Corporation, and JFE Steel. Malaysia's national electricity company TNB joined the list in May.
- In contrast, some companies that had received several shipments before May, did not take further cargoes during the month. This includes Kyushu Electric Power, Tohoku Electric Power, KEPCO, Hyundai Steel, Sumitomo, Mitsubishi and Enagas. It's not clear if they have terminated purchases or simply did not have deliveries in May.

Largest importers of fossil fuels from Russia

in the first 100 days of the invasion



Introduction

More than 100 days have passed since the Russian military started its illegal full-scale invasion of Ukraine. These 100 days have witnessed war crimes, atrocities and human suffering on a staggering scale.

Revenue from fossil fuel exports is the key enabler of Russia's military buildup and aggression. Recently, the country's finance minister Anton Siluanov [boasted](#) on state television that despite the reluctance and looming bans on Russian fossil fuels, the country's earnings from fossil fuel exports will increase by up to 14 billion euros this year (due to high prices) and a part of the increase in revenue will be used to fund the "special operation" in Ukraine.

Russia spends an [estimated](#) EUR 840 million per day on the invasion; the revenue from fossil fuel exports exceeded this sum during the first 100 days.

Ukraine's government and civil society have been clear in their calls to terminate all fossil fuel purchases and other business with Russia's regime; yet most countries and companies have continued to buy oil, coal and gas from the aggressor.

There has been progress. The U.S. and Canada have imposed fossil fuel import bans that are already in effect. The [UK](#) will phase out the imports of crude oil and oil products by the end of 2022. The EU has banned coal imports from August and on seaborne oil imports from December; these make up 75% of the total oil imports into Europe. Germany has vowed to stop oil imports by the end of the year, which will eliminate most of the pipeline imports. Poland, Bulgaria, Finland, Denmark and Shell have refused to pay for gas imports in rubles, resulting in Gazprom refusing to fulfill contracts with them.

Some companies, including BP, Shell, Total, ENEOS (Japan), Neste Oil (Finland), Orlen (Poland), Tata Steel and Kyushu Electric Power have [made announcements](#) to stop some or all purchases. In most cases, deliveries still take place under existing contracts for some months.

The record-high fossil fuel prices and the moral abhorrence towards reliance on Russia have also [shocked](#) many European countries into accelerating the transition away from fossil fuels. Targets and policies announced by the European Union and different member states mean 31% less power generation from fossil fuels. Furthermore, the latest policies adopted by European Union countries will increase the share of electricity from renewables to 63% by 2030 from a previous expected target of 55% while [REPowerEU](#) will lead to a further increase to 69%. Finally 19 European countries have announced increased ambition to decarbonize their economies. Five countries have also created new programmes to improve house insulation and accelerate the deployment of heat pumps. This means that fossil fuel phase-out in the EU happens faster than previously targeted, and will lessen the impact of banning imports from Russia.

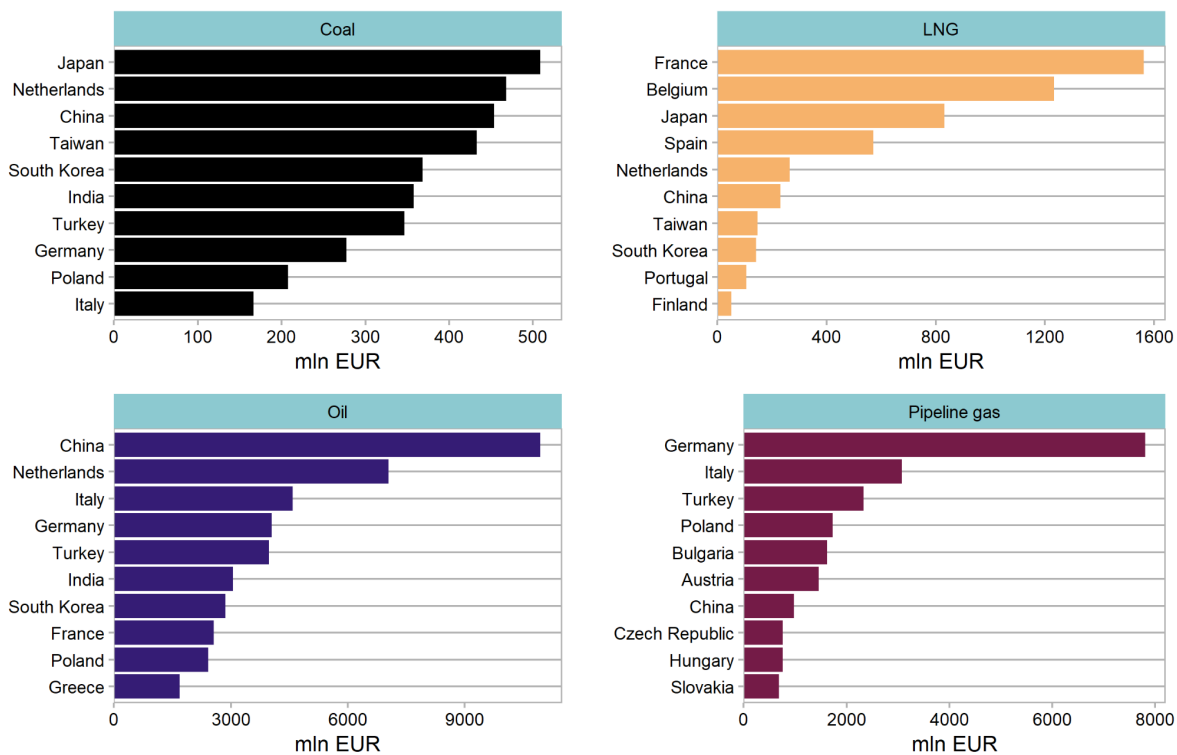
Fossil fuels are filling Kremlin's war chest: Russia exported 93 billion EUR worth of fossil fuels in the first 100 days of the invasion

- 93 billion EUR worth of fossil fuels were exported from Russia since the beginning of the invasion. 63% of export revenues came from oil and oil products and 32% from fossil gas, with coal making up 5%.
- The EU bought 61% of Russian fossil fuel exports, worth approximately 57 billion EUR. The share of the EU was approximately 30% for coal, 50% for crude oil, 75% for LNG, 75% for oil products and 85% for pipeline gas.
- The largest importers were China (EUR12.4bln), Germany (EUR12.0bln), Italy (EUR8.3bln), Netherlands (EUR7.7bln), Turkey (EUR6.6bln), Poland (EUR4.3bln), France (EUR4.3bln), South Korea (EUR3.4bln) and India (EUR3.3bln) and Belgium (EUR2.6bln).
- The largest importers of oil were China, the Netherlands, Italy and Germany; the largest importers of pipeline gas Germany, Italy and Turkey; the largest importers of coal Japan, the Netherlands, China (mainland) and Taiwan; and the largest importers of LNG France, Belgium, Japan and Spain.

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Largest importers of fossil fuels from Russia

in the first 100 days of the invasion

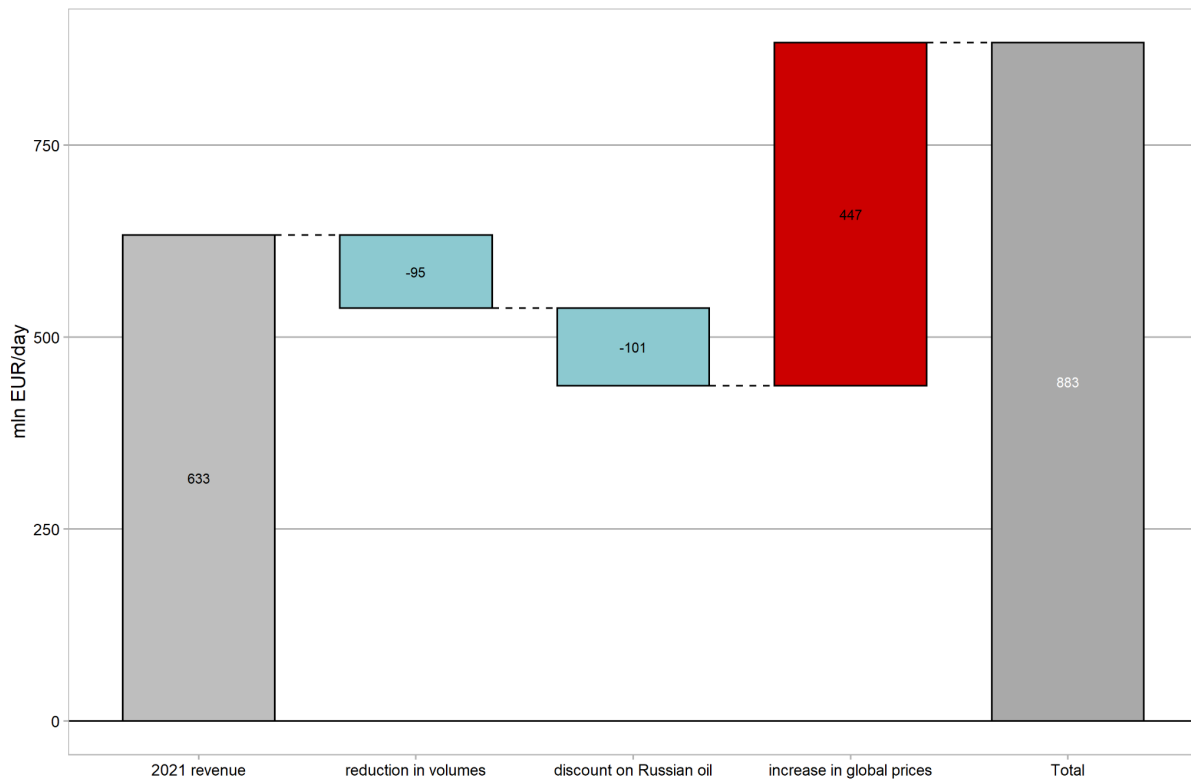


Note different scales on x-axis.

Russia's energy export revenues have been falling since March, but remain record-high

- Import volumes fell modestly in May, around 15% compared with the time before the invasion, as many countries and firms shunned Russian supplies.
- However, increase in fossil demand has created a windfall: Russia's average export prices were an average 60% higher than last year, even if they were discounted from international prices.

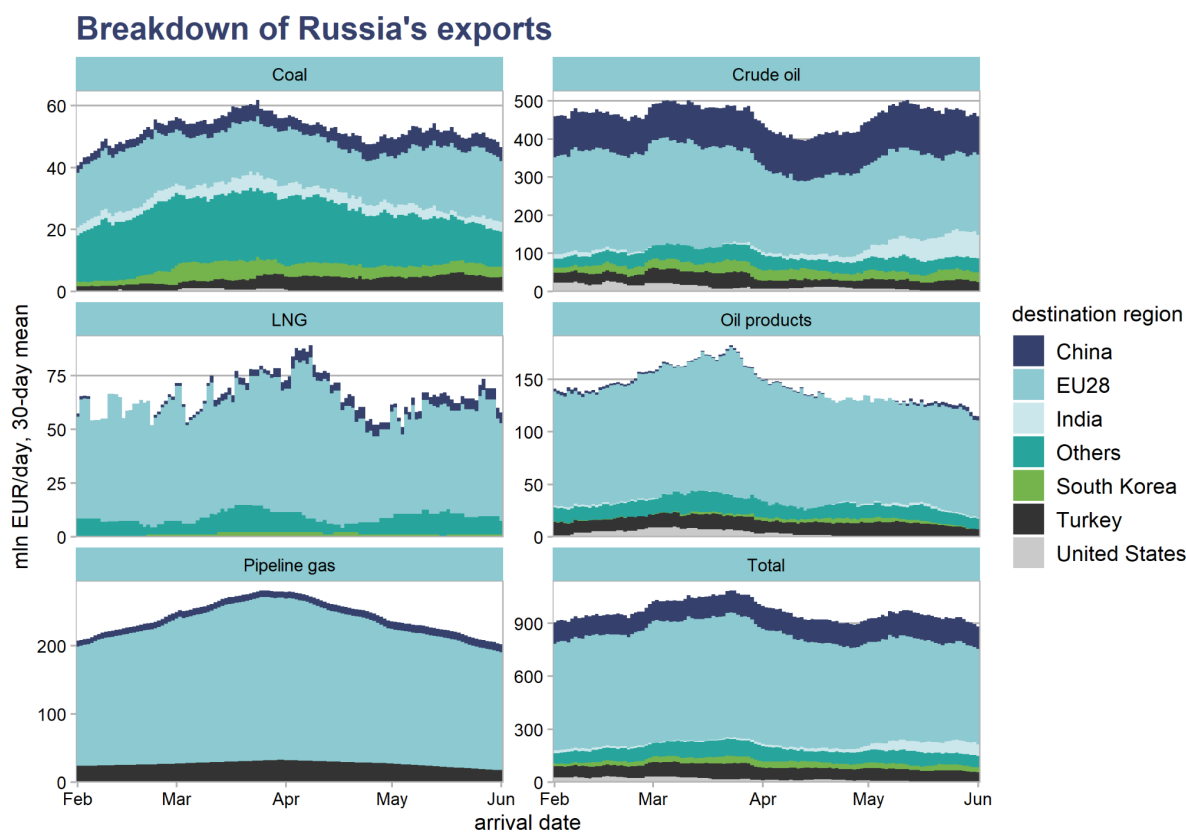
Change in Russia's fossil fuel export revenues from May 2021 to May 2022



- The price discount and drop in physical volumes both contributed equally to reduce Russia's fossil fuel export revenues in May. Fossil gas pipeline imports from Russia fell by 25% compared to the February-March period, on seasonally adjusted basis, due to increased imports of LNG and of pipeline gas from Norway, as well as due to Russia's decision to cut gas supplies via Poland. Oil physical volumes fell by a modest 7%, with crude oil volumes rebounding to February-March levels and oil products falling by 25%.

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- The reduction in demand and the discounted price for Russian oil cost the country approximately 200 million EUR per day in May. Nevertheless, Russia still made an estimated 880 mln EUR per day from energy exports compared to 1.1 bln EUR per day in January-February 2022.
- Crude oil exports from Russia fell in April but rebounded in May, coinciding with a drop in oil products exports. This represents a shift in trade flows, with Russian crude oil now being processed in foreign countries. Coal and LNG imports remain relatively stable.

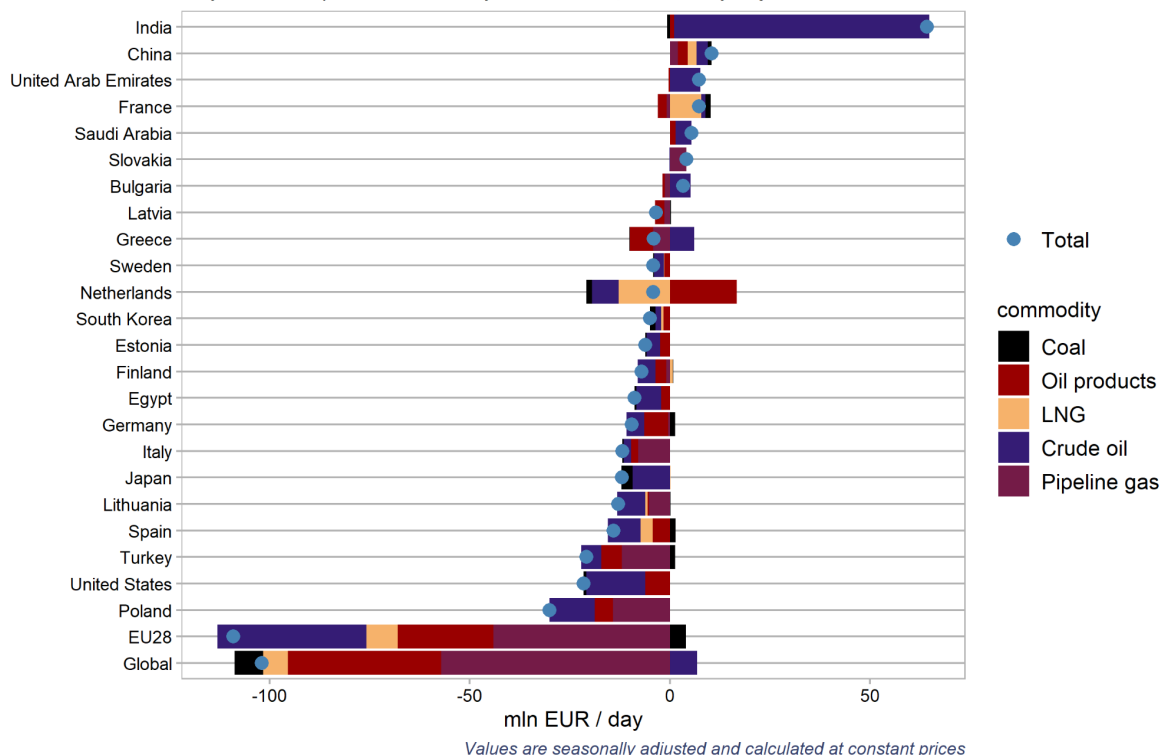


Country-by-country trends

- China overtook Germany as the largest importer. China's imports have been essentially constant while Germany has managed to cut its oil imports from Russia by approximately 25%; other imports didn't change.
- The largest contributors to the reduction in import volumes were Poland, United States, Turkey, Spain, Italy and Japan.

Changes in monthly import volumes from Russia

May 2022 compared to February-March 2022, seasonally adjusted

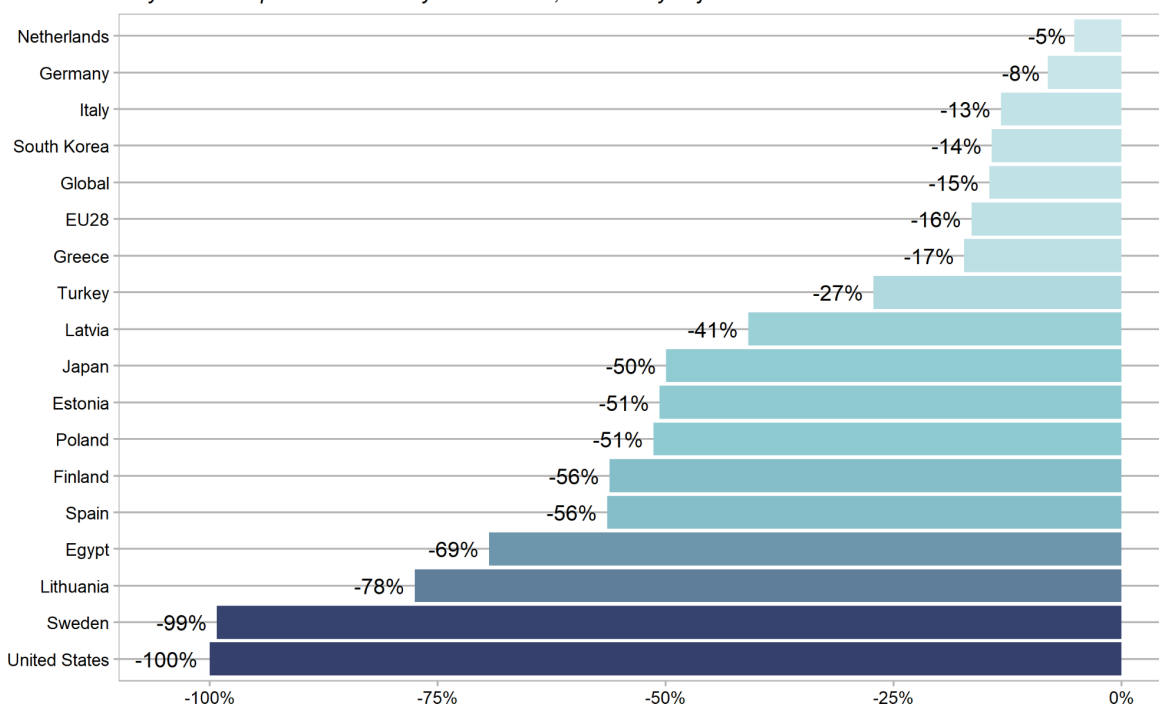


- In relative terms, the most decisive countries in cutting Russian energy imports were the United States (-100%), Sweden (-99%), Lithuania (-77%), Egypt, Spain, Finland, Poland, Estonia and Japan.
- Crude oil imports into the EU fell by 18% in May. However, this reduction was taken up by India and the United Arab Emirates, leading to no net change in Russia's crude oil export volumes.

- There are some in-land European countries who bumped up imports of natural gas (Slovakia, Czechia, Austria), potentially to fill the gap on the market due to the Yamal-Europe pipeline halt.
- The record-high fossil fuel prices and the drive to reduce reliance on Russia have prompted [increased ambition](#) for clean energy and energy efficiency across Europe, which will effectively lessen the impact of banning imports from Russia. Spreading the most effective national policies across the bloc and beyond could substantially increase the impact.

Reductions in monthly import volumes from Russia

May 2022 compared to February-March 2022, seasonally adjusted



Values are seasonally adjusted and calculated at constant prices

Countries with the largest absolute reductions are shown.

Significant reduction in EU's gas imports

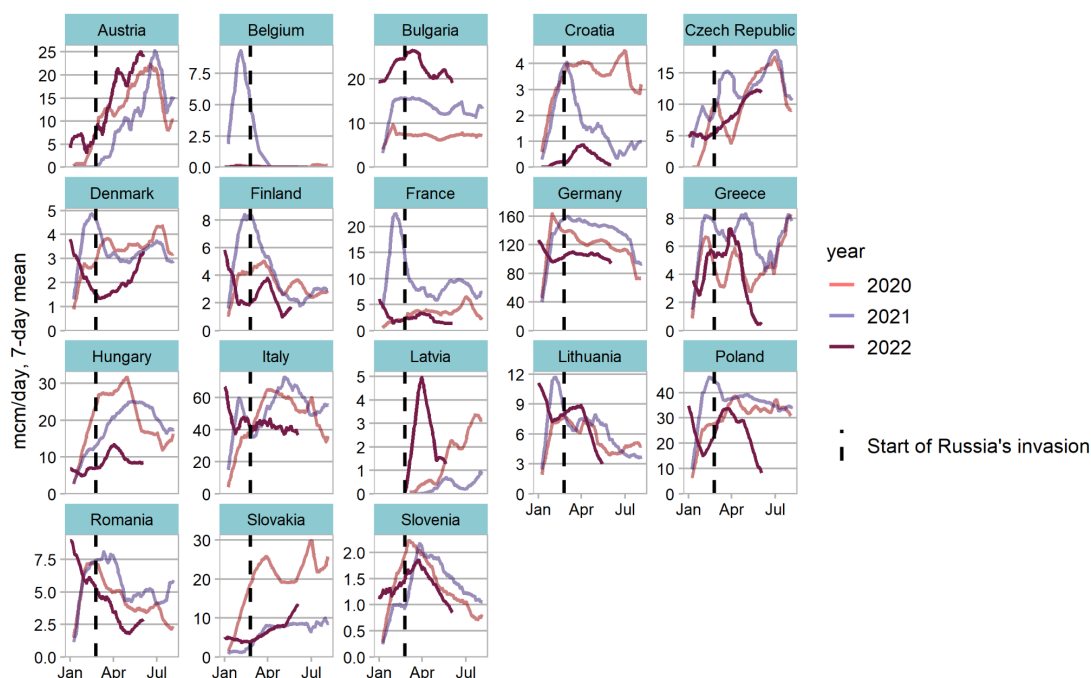
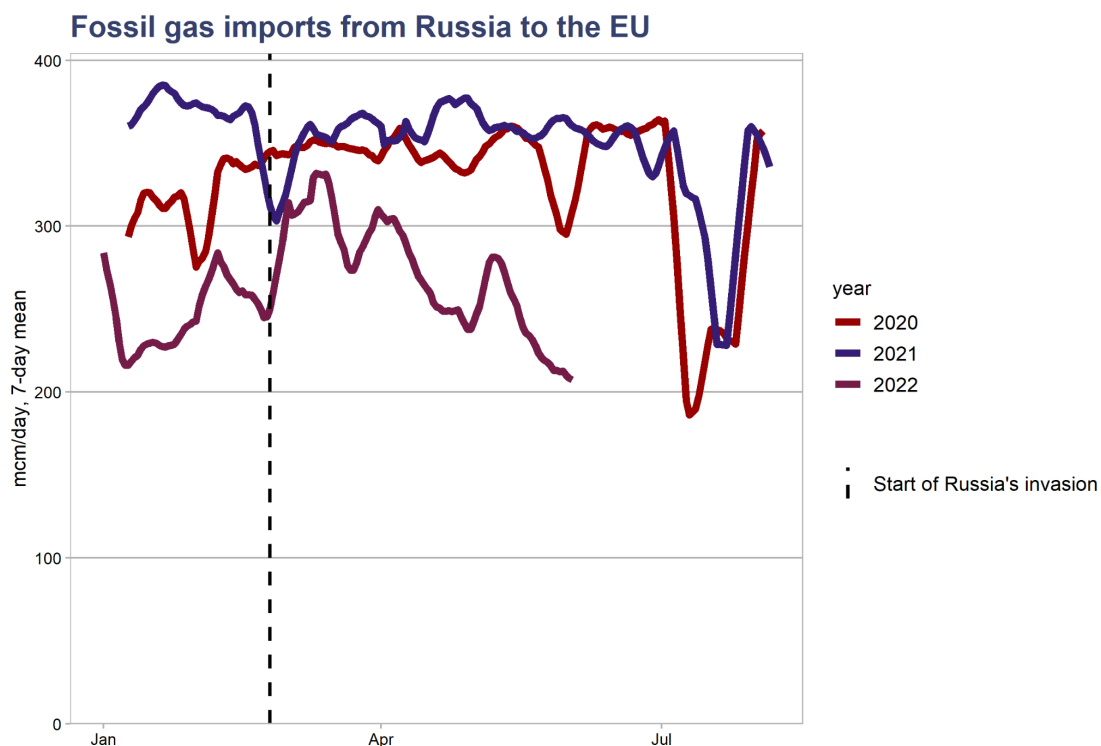
[EU](#) gas imports from Russia declined by 23% in the first 100 days of the invasion. In the first two weeks, imports increased to the highest volume observed this year, but have declined afterwards, falling 30% year-on-year in May. Most significantly, [Germany](#)'s imports of Russian gas fell by 31%, and by 70% in Poland and Lithuania. However, Gazprom's revenue is still twice as high as the year before, due to high prices.

Poland's gas imports from Russia plummeted after Poland refused to entertain Russia's ruble payment scheme and Gazprom terminated sales to the country. Supplies to Bulgaria were cut off at the same time, and Finland's soon after. However, with the exception of Poland, those countries have continued to import indirectly, through their neighbors, according to our analysis of physical gas flows.

Austria and Bulgaria are importing more than in the past years, and Czechia and Denmark have rebounded. However, Danish utility Ørestad refused to comply with Russia's ruble payment scheme and had sales cut off; the effect on physical flows will be seen soon.

In the run-up to the invasion, Gazprom deliberately throttled gas sales, and the winter was mild. As a result, imports of Russian gas were below the lowest levels seen in 2015–2020. After the invasion, import levels surged to previous years' levels, as gas buyers scrambled to secure supplies and high gas prices made Russian gas economically attractive. After that initial jump, import volumes have fallen steadily, being replaced mainly by LNG.

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Physical flows from ENTSOG apportioned with CREA gas trade model

Anticipating the effects of EU's oil embargo

The [European Union](#) leaders have agreed on the sixth package of sanctions against Russia to be enforced at the end of a six months period. The partial embargo will cover roughly 75% of Russian oil delivered to the European Union. As Germany and Poland have also committed to stop pipeline deliveries from Russia, 93% of Russian oil sales to the EU are due to be eliminated by the end of the year.

The Russian oil embargo is partial due to exemptions given to Hungary, Czech Republic and Slovakia who will continue to buy Russian oil delivered through the Druzhba pipeline without a set date for a complete phase-out. An exemption appears to have been offered also to Bulgaria which imports roughly 0.1 million barrels per day via a Lukoil owned refinery in Bourgas.

The [European Union](#) imported 2.3 million barrels per day in 2021 from Russia, equivalent to about 24% of total imports. Italy and the Netherlands were among the largest imports, receiving 1.6 million crude barrels per day via the sea route. The rest, around 0.72 million barrels per day, were pumped along the Druzhba pipeline to Germany, Poland, Czech Republic, Hungary and Slovakia. The Czech Republic, Hungary and Slovakia import together around 0.3 million barrels per day via the Druzhba pipeline and together with Bulgaria account for a maximum of 17% of Russian crude delivered to the European Union.

The impact of the sanctions will be significant despite the mitigation offered by the current high prices. [Russian](#) custom data shows that the oil exports to the European Union were worth 50 Billion EUR in 2021 which translates into an average price per barrel of 70 USD, in line with the [Brent](#) average price for 2021. The average [Brent](#) oil price for May 2022 was 113.34 USD. Assuming the current price remains at these high levels and the [Ural](#) discount to Brent remains at 35 USD per barrel, Russian oil delivered to the four exempted countries, mostly via the Druzhba pipeline¹ will represent approximately 14.2 Billion EUR, slightly more than a quarter of the value of the oil delivered to the EU in 2021. If prices decrease from current levels, the final amount should decrease accordingly.

While Russia can sell the oil to other markets, such as the ones in Asia, this was made even more difficult by sanctions covering the insurance sector recently announced by both the EU and the United Kingdom. The two entities have agreed on a ban on insuring ships carrying Russian oil. Russian oil has thus become effectively uninsurable on the key insurance market of [Lloyd's](#) of London, which will significantly diminish Russian capacity to export oil.

¹ The oil flowing through the Druzhba pipeline is assumed not to be discounted from the Brent price as these are not seaborne flows, do not involve high freight rates and maritime insurance. However, we assumed the oil flowing to Bourgas, in Bulgaria was discounted by 35 USD per barrel from the Brent Price as it is seaborne.

India, Middle East, France and Belgium are dipping into discounted Russian fuels

- India, France, China, United Arab Emirates and Saudi Arabia increased imports.
- India became a significant importer of Russian crude oil, buying 18% of the country's exports. A significant share of the crude is re-exported as refined oil products, including to the U.S. and Europe, an important loophole to close.
- European buyers, in France, Belgium and the Netherlands, bought most of the short-term cargoes at a discount, buying LNG and crude oil on the spot market. These purchases take place outside of pre-existing contracts, therefore always representing an active purchase decision.

Largest buyers of "for orders" cargoes in April-May

destination country	value, mln EUR	number of shipments	commodities
France	899	12	LNG, Crude oil, Oil products
Netherlands	480	14	Crude oil, Oil products
Belgium	427	8	LNG, Oil products, Crude oil
Turkey	395	13	Oil products, Crude oil
Italy	367	7	Crude oil, Oil products
Greece	282	6	Oil products, Crude oil
Spain	137	2	LNG, Oil products
United Arab Emirates	129	2	Crude oil

CREA tracks short-term purchases based on the history of ship destination reports. Ships that reported "for orders" or some variant as their destination at some point after departure are included; the destination country is the actual country where ship unloaded its cargo, according to MarineTraffic.com.

India's refining trade

Indian refineries have become major importers of Russian crude oil, with India's share of Russia's total crude exports shooting up. It rose from around 1% before the invasion to 18% in May. The largest buyer is the Jamnagar refinery, which got 27% of its oil from Russia in May, up from less than 5% before April. Arrivals from Russia have mainly replaced arrivals from other sources, but there is also an uptick in crude intake since the start of April when the arrivals from Russia started to rise sharply.

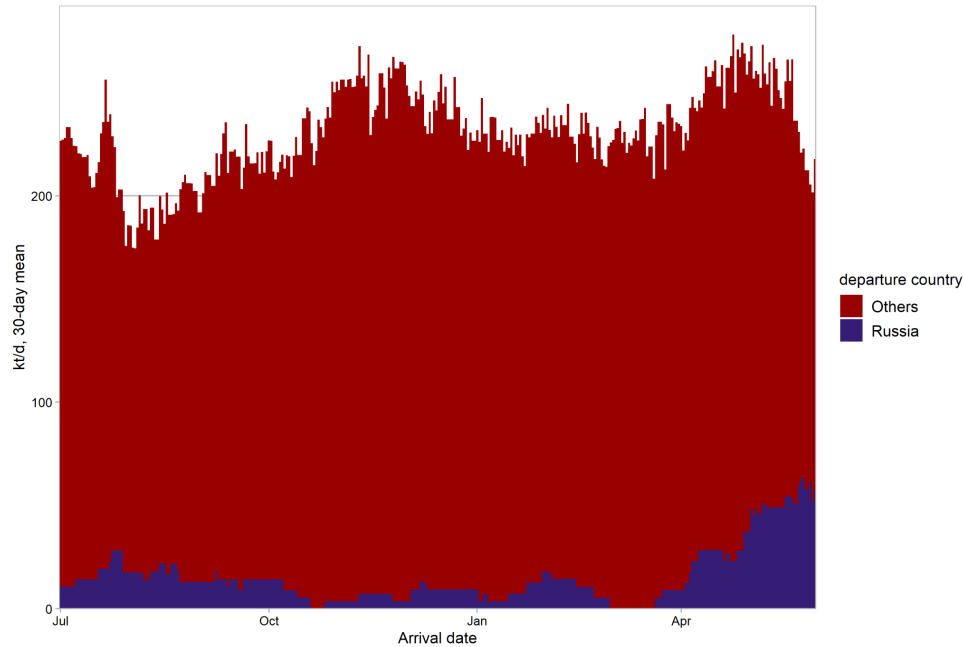
Much of the oil is re-exported: more than half of the refined oil deliveries from Jamnagar go outside of India. Approximately 20% of exported cargoes left for the Suez canal, indicating that they were heading to Europe or the U.S. We identified shipments to the United States, France, Italy and the UK.

Due to long shipping distances, the emergence of “India's refining trade” has meant that more tanker capacity than ever before is needed to ship Russian crude. This is a key vulnerability — strong sanctions against tankers transporting Russian crude would significantly limit the scope for this kind of rerouting of Russia's exports. In April-May, 67% of deliveries of Russian crude oil were made with ships owned by European and U.S. companies. For deliveries to India and the Middle East, the share was even higher at 80%, with Greek tankers alone carrying 56%. 97% of tankers carrying Russian crude were insured in just three countries, UK, Norway and Sweden.

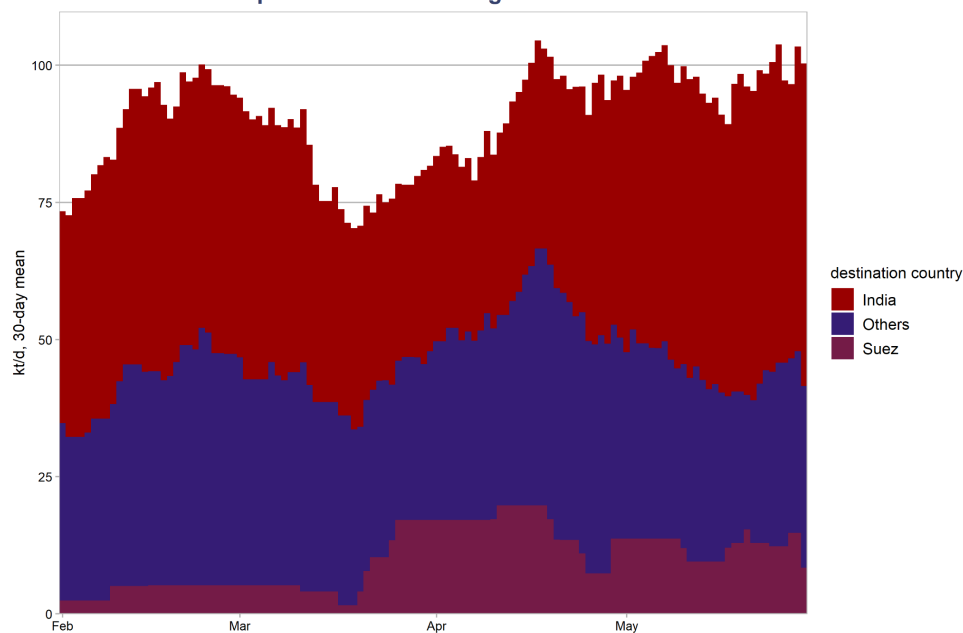
Tanker rates are already at [record highs](#), after a very modest reduction in EU imports. The shortage of tanker capacity and long distances are already causing Russian exporters to resort to workarounds such as [ship-to-ship transfers](#).

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Crude oil tanker arrivals in Jamnagar



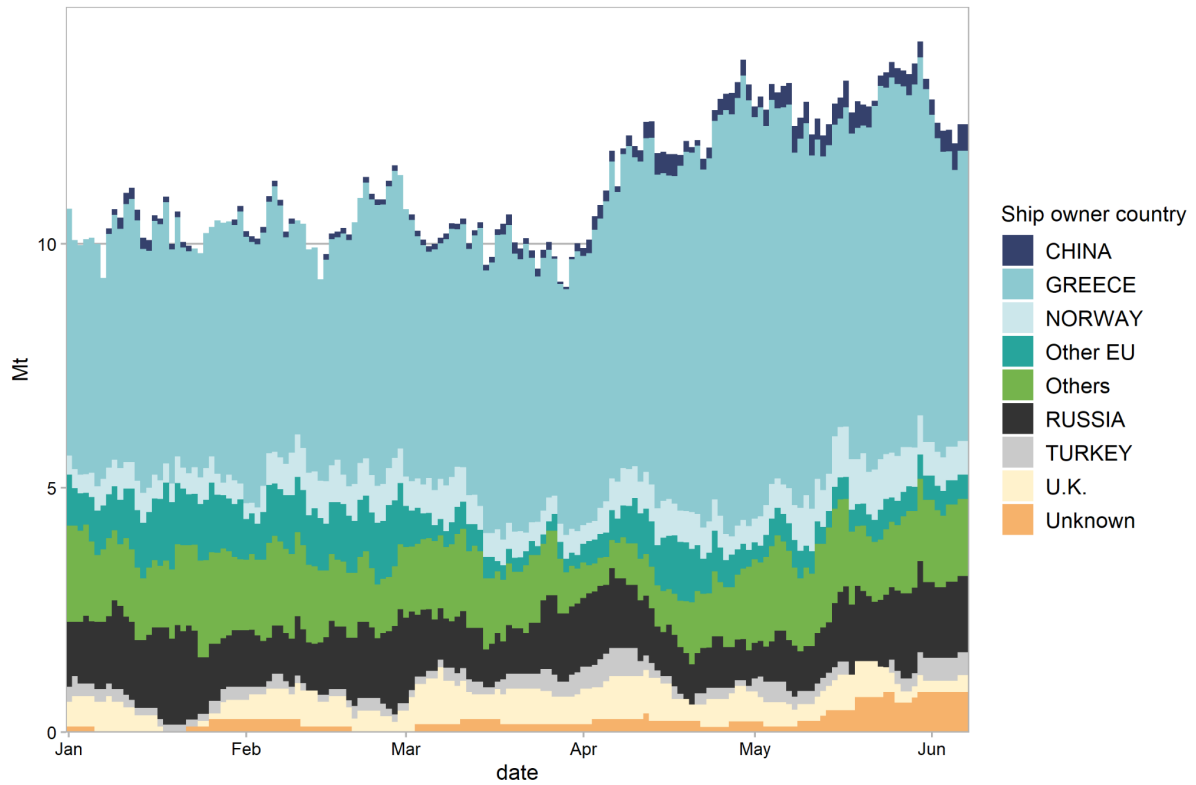
Product tanker departures from Jamnagar



Ships reporting “Suez” as their destination upon departure from India are generally heading to Europe or the U.S.

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Tanker capacity carrying Russian crude



13 oil, power and industrial firms continued purchases in May while others wound down

- In our previous analysis, we identified 23 large companies that bought Russian fossil fuels in the first two months of the war. 13 of these have continued purchases in May: oil companies Exxon, Shell, Total, Repsol, Lukoil, Neste, and Orlen; power utility companies Taipower, Chubu Electric Power, TEPCO and Trieste thermal power plant; and industrial companies Nippon Steel, POSCO, Formosa Petrochemical Corporation, and JFE Steel. Malaysia's national electricity company TNB joined the list in May. Indian refiners Reliance, Nayara Energy, BPCL and IOCL emerged as new buyers with increased volumes.
- In contrast, some companies that had received several shipments before May, did not take further cargoes during the month. This includes RWE, Kyushu Electric Power, Tohoku Electric Power, KEPCO, Hyundai Steel, Sumitomo, Mitsubishi and Enagas. It's not clear if they have terminated purchases or simply did not have deliveries in May.
- Rotterdam and Antwerpen remain the main destinations for crude oil and oil products exports from Russia. These ports house the refineries of major oil companies supplying the European market. Trieste in Italy acts as a transshipment port to Germany and Austria.
- Taiwanese ports stand out as destinations for coal imports as Taipower and Formosa Plastics have continued imports. Fluxys terminals in France and Belgium are the main destinations for Russian LNG deliveries.

The tables in the next pages show the largest importing ports for Russian fossil fuels in the first 100 days of the invasion, and the operators of facilities that received cargoes. We took the arrival port for each shipment from MarineTraffic.com data, identified the specific port facilities where the cargoes were discharged based on ship positioning data during the port visit, and then assigned owners or operators to those port facilities. Discharge of cargo is detected based on changes in the ship's reported draught. This approach gives us a detailed picture of where Russian fossil fuel is being shipped and the companies involved in the trade, but there is always a possibility of ship movements being misinterpreted. We are interested in clarifications or corrections from any of the commercial actors listed.

Largest crude oil importing ports

area	port	value of	tonnage of	known operators	latest	number of
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		shipments, mln EUR	shipments, kt		arrival	shipments
Netherlands	Rotterdam	2838	5345	BP; Vopak; OCI; ESSR B.V.; Stargate Oil Terminal Rotterdam B.V.; Shell Nederland	2022-06-02	47
Netherlands	Maasvlakte	1979	3645	Vopak, Aramco Overseas, BP, ExxonMobil, Shell, Total, Lukoil.	2022-06-02	32
Italy	Trieste	1956	3713	Seastock S.r.l.	2022-05-30	30
India	Sikka	1318	2624	Reliance	2022-05-31	20
South Korea	Yeosu	1080	1793	Chevron and GS Energy	2022-06-01	17
Turkey	Nemrut Bay	979	1887	SOCAR state oil company of Azerbaijan	2022-05-26	16
China	Lanshan	936	1578	Lanqiao Group; Beijing Energy International Holding Co; China Huadian	2022-05-29	14
Poland	Gdansk	910	1680	PERN	2022-05-30	15
Bulgaria	Burgas	886	1713	Lukoil Neftohim Burgas (Russian); Seastock S.r.l.	2022-05-31	15
Italy	Santa Panagia	833	1611	Iplom	2022-06-01	14

Largest LNG importing ports

area	port	value of shipments, mln EUR	tonnage of shipments, kt	known operators	latest arrival	number of shipments
Belgium	Zeebrugge	3700	3237	Fluxys	2022-05-28	60
France	Montoir-de-Bretagne	1286	1162	Elengy; Fluxys	2022-05-21	12
Netherlands	Maasvlakte	529	433	Gasunie (50%); Vopak (50%)	2022-04-03	8
France	DUNKIRK	515	484	Fluxys	2022-05-27	5
Spain	Bilbao	465	387	Bahía Bizkaia Gas	2022-05-05	4
Japan	Kisarazu	146	243	JERA	2022-05-15	3
China	Tianjin Xingang Pt	133	317	Sinopec	2022-05-22	4
Japan	Niigata	111	165	Tohoku Electric Power	2022-04-18	2
Taiwan	Yung-an	107	159	CPC Corporation	2022-04-05	2
South Korea	Anjeong	106	255	Kogas	2022-05-17	3

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Largest oil products importing ports

area	port	value of shipments, mln EUR	tonnage of shipments, kt	known operators	latest arrival	number of shipments
Belgium	Antwerpen	963	1554	Vesta; Sea Invest Group; Gunvor Petroleum; Zuidnatie NV; Schramm Group	2022-05-27	38
Netherlands	Rotterdam	847	1367	Stargate Oil Terminal Rotterdam B.V.; Vopak; OCI; BP; Gazprom	2022-05-27	33
Latvia	Ventspils	480	777	VNT	2022-05-30	18
Germany	Hamburg	476	768	Oiltanking Deutschland GmbH; EVOS Hamburg GmbH; Schramm Group	2022-06-01	24
Estonia	Sillamäe	435	701	Sillamae Oil Terminal AS	2022-06-01	41
Netherlands	Amsterdam	412	663	Zenith Energy; Eurotank Amsterdam; JERA Global Markets; Exolum Group	2022-05-20	15
Romania	Constanta	399	647	Oil Terminal S.A.; Rompetrol Rafinare	2022-05-20	20
Greece	Agio Theodoroi	362	586	Motor Oil (Hellas) Corinth Refineries	2022-05-28	15
Turkey	Körfez	272	472	Tüpraş; TÛPRAŞ	2022-05-09	12
United Kingdom	Immingham	231	376	Associated Petroleum Terminals (Immingham) Ltd	2022-05-13	8

Largest coal importing ports

area	port	value of shipments, mln EUR	tonnage of shipments, kt	known operators	latest arrival	number of shipments
Netherlands	Maasvlakte	241	1575	EMO	2022-05-25	20
Germany	Hamburg	136	897	Hamburg Port Authority	2022-05-13	10
Taiwan	Kaohsiung	91	555	Taipower; Others	2022-05-29	12
Taiwan	Mai-liao	112	690	Formosa Petrochemical Corporation	2022-05-18	4
Turkey	Iskenderun	104	646	Oyak Mining Metallurgy Group; MMK Metalurji; Ekinciler Group	2022-05-31	20
Netherlands	Amsterdam	90	585	EMO; HES International; JERA Global Markets	2022-05-25	7
China	Caofeidian	75	890	Hebei Port Group	2022-05-29	20
Germany	Wilhelmshaven	70	453	Uniper, Onyx	2022-05-23	5
Morocco	Jorf Lasfar	67	751	TAQA Morocco (formerly Jorf Lasfar Energy Company)	2022-05-29	11
Malaysia	Port Klang (Pelabuhan Klang)	67	411	Tenaga Nasional Berhad	2022-05-03	5

Policy recommendations

CREA encourages all governments and corporate buyers of Russian fossil fuels to

- end all purchases, in order to strengthen the effect of the sanctions and help end the war and the crimes against humanity committed by the Russian military.
- sanction all involvement in transporting of Russian fossil fuels to third parties.
- during any wind-down or transition period, or if a full ban isn't plausible, institute tariffs on imports from Russia. Sufficiently high tariffs would encourage buyers not to purchase from Russia whenever possible, and curb the price paid to Russian suppliers on spot markets.
- create a plan to replace Russian fossil 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 (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 products 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.

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 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 lack of transparency on transactions, tracking the physical flows is the best way we have of approximating where Russian gas ends up in Europe.

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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 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 ENTSG. 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/>
- ENTSG transparency platform: <https://transparency.entsg.eu/>
- UN COMTRADE: <https://comtrade.un.org/Data/>



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About CREA

Centre for Research on Energy and Clean Air (CREA) is an independent research organisation 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.

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 wellbeing, safety, and dignity that our organisation 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.