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"Igor Sikorsky
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Study of energy independence of European countries in the context of new global security challenges

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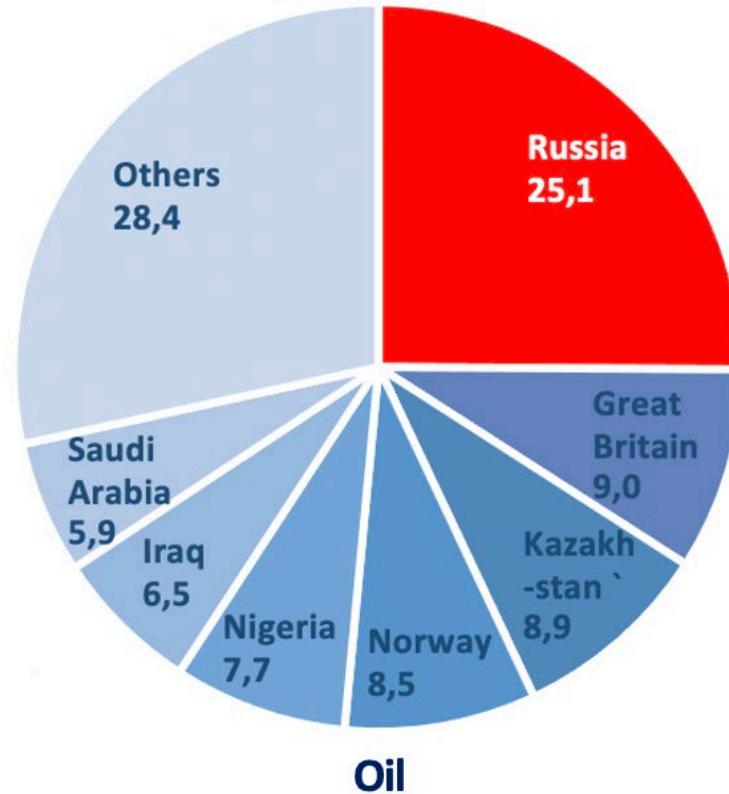
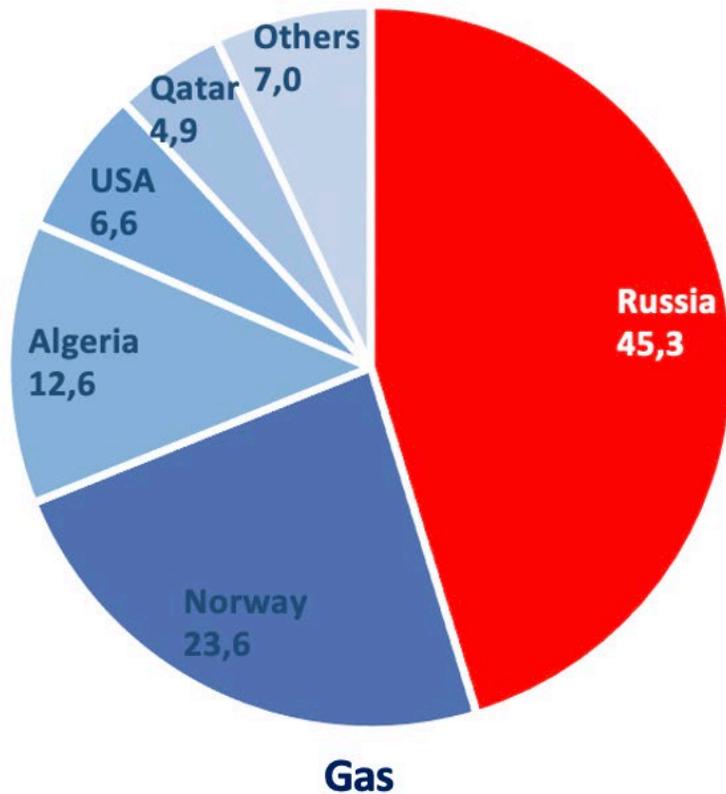
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STRUCTURE OF THE THE EUROPEAN UNION IMPORTS OF MAJOR FOSSIL FUELS, 2021



The European Union imports 90% of its gas consumption.

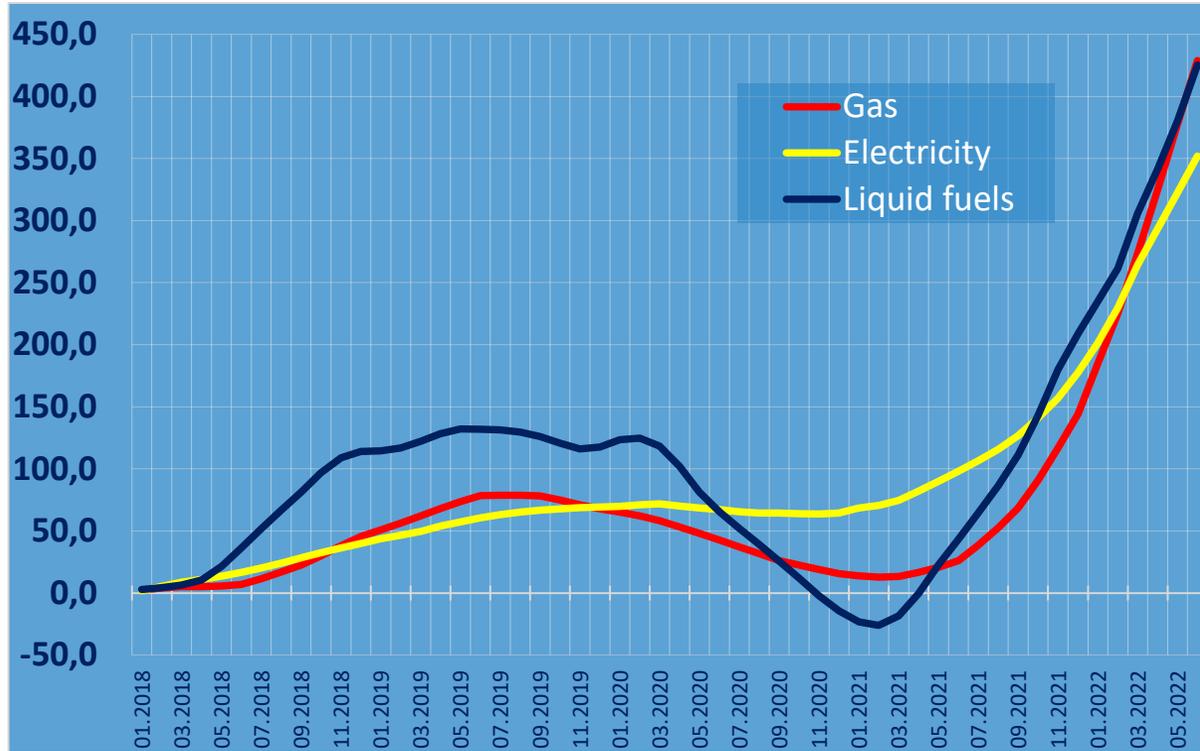
Until 2022, the share of the Russian Federation in these imports was 45%.

Russia also accounted for about 25% of oil imports and 45% of coal imports.

EVOLUTION OF THE EUROPEAN UNION ENERGY PRICES, 2018–2022

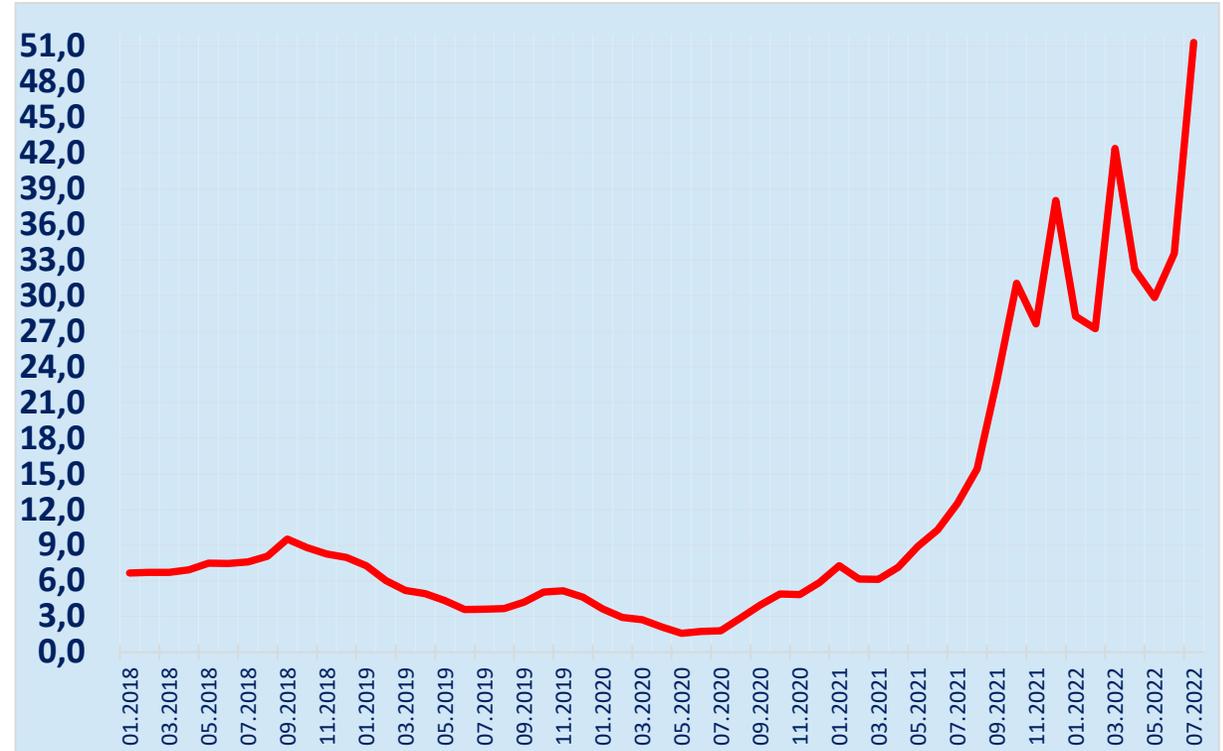


Russia's average fossil fuels export prices in 2022 were about 60% higher than last year



Eurostat

**Energy prices,
01.2018 – 07.2022, annual rate of change**



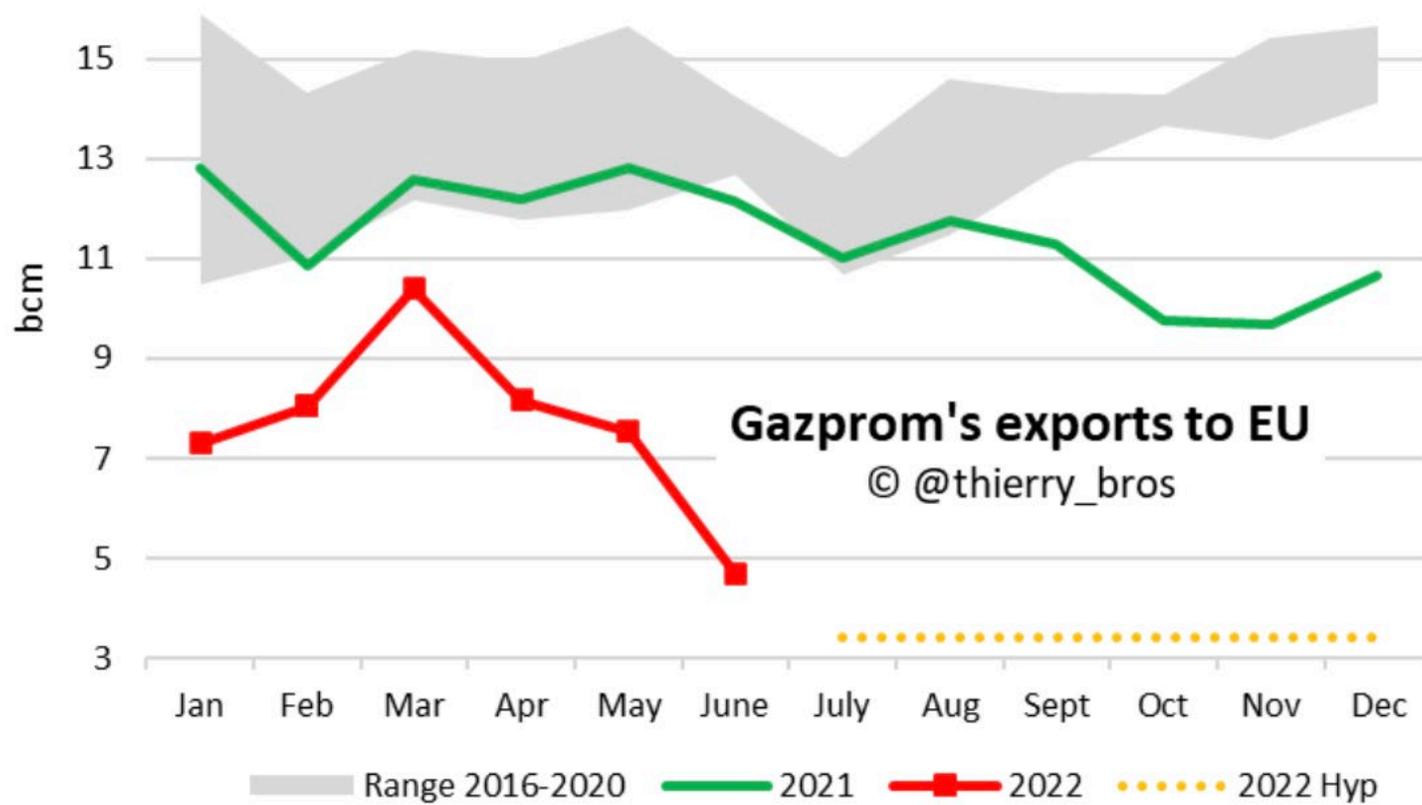
Eurostat

**Natural gas price,
01.2018 – 07.2022, USD per 1 million
BTU**

EVOLUTION OF GAZPROM'S EXPORTS TO THE EUROPEAN UNION, 2016–2022



In 2022 fossil fuel exports from Russia fell by 300 TWh or about 22% of EU consumption.

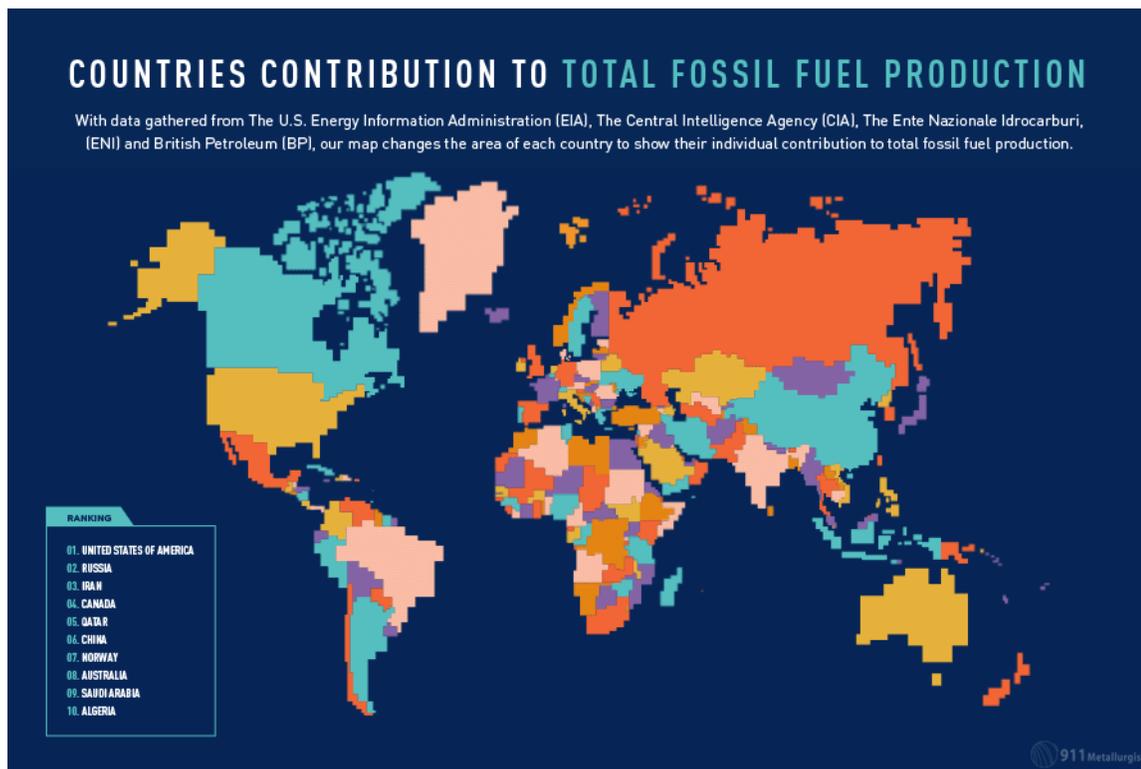


- ▶ Some countries, such as Latvia, Estonia, and Lithuania, have refused to buy Russian gas, while others significantly reduced imports of fossil fuels;
- ▶ Russia has cut off gas to Poland, Bulgaria, Finland, Denmark, and the Netherlands because they had refused to pay their bills in Russian currency, and has reduced supplies to six more countries.

RUSSIA'S FOSSIL FUELS HAVE BECOME AN IMPORTANT GEOPOLITICAL FACTOR



Russia has earned more than triple its usual revenues from exports to the EU so far this year due to the exceptionally high prices.



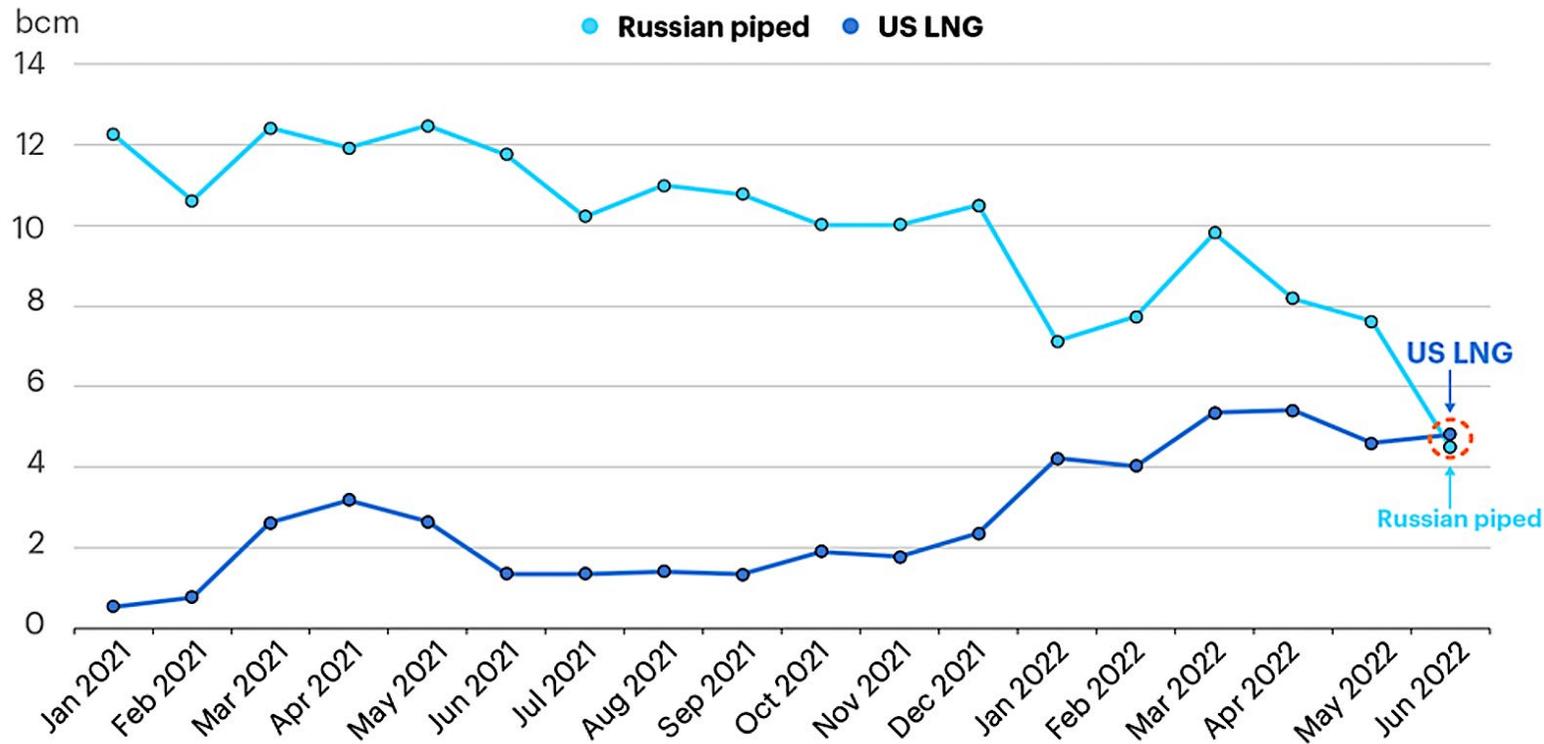
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Russia sells 70% of its gas and 60% of its oil and oil products to Europe. The EU pays per day EUR 450 million for oil and EUR 400 million for natural gas imports.

This is equivalent to the estimated cost of 160 Caliber cruise missiles launched in Ukraine.

This money has softened the impact of Western sanctions on Russia's commodity economy. The oil and gas sector brings in up to half of its budget revenues and more than half of its exports.

EVOLUTION OF THE EU GAS IMPORTS VIA LNG TERMINALS FROM THE USA AND VIA PIPELINE FROM RUSSIA, 2021 – 2022



© International Energy Agency

**Gas imports,
01.2021 – 06.2022, BCM**

June 2022 has become the first month in history in which the EU has imported more gas via LNG terminals from the US than via pipeline from Russia. But in July gas flows through Nord Stream 1 were restarted.

At average demand levels, the EU estimate that a full disconnection from Russian gas imports could result in a deficit of 30 BCM of gas by March next year.

THE EUROPEAN UNION PROGRAMS OF ABANDONMENT OF RUSSIAN FUEL IMPORTS



Fit for 55 – a program presents a set of legislative initiatives to ensure that EU policies are in line with climate goals, but is rather slow, with a deadline of 2050.

REPowerEU – a preliminary plan to eliminate dependence on Russian fossil fuels by 2030. According to it, it is expected to reduce EU demand for Russian gas by 100 billion cubic meters or two-thirds of the total by the end of 2022.



A 10-Point Plan to Reduce the European Union's Reliance on Russian Natural Gas – a more detailed plan presented in March 2022 by the International Energy Agency.

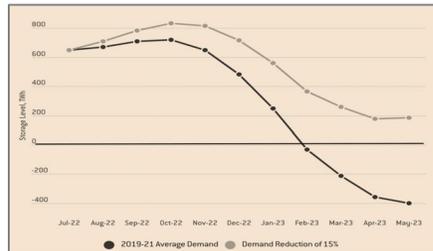
Save Gas for a Safe Winter – new European gas demand reduction plan to prepare for supply cuts and reduce gas use in EU by 15% until next spring.



THE EUROPEAN UNION PROGRAMS OF ABANDONMENT OF RUSSIAN FUEL IMPORTS



In general, the updated energy supply programs of the EU countries envisaged by the above-mentioned acts are based on three main directions:



The first direction is to save energy and reduce the demand compared to the previous years' consumption. In particular, it is planned a 15% reduction between 01.08.2022 to 31.03.2023.



The second direction is to diversify supplies and attract more renewable gas sources. In particular, it is planned to increase LNG imports.

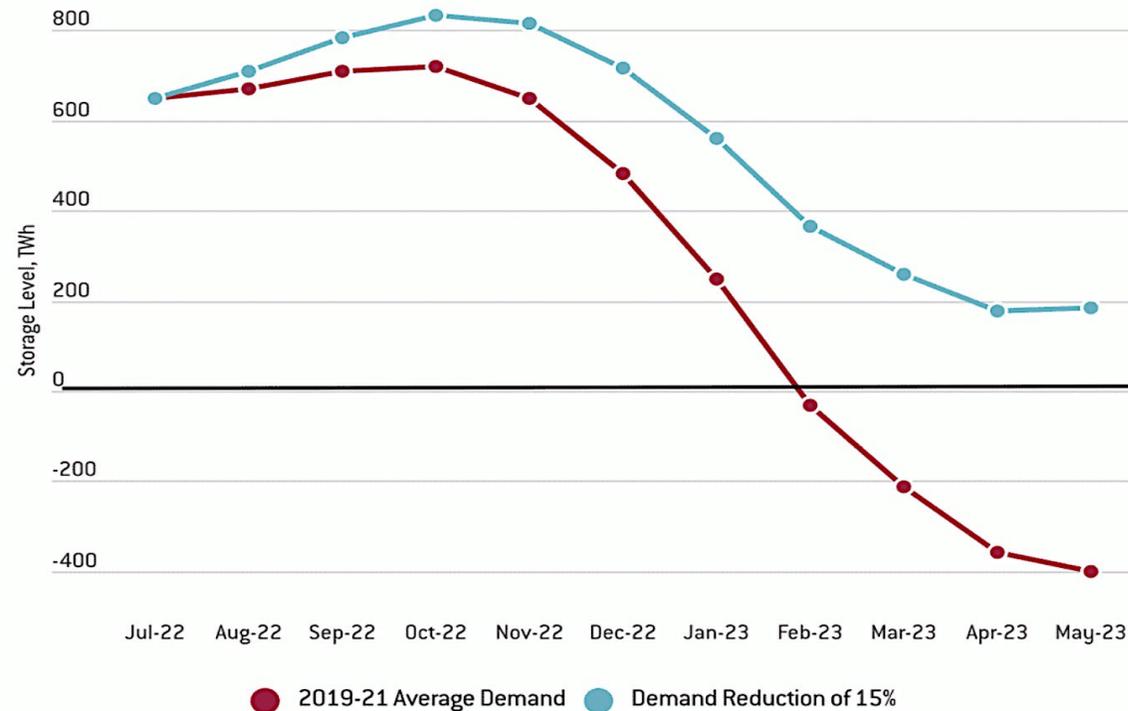


The third direction is to accelerate the transition to production and use of clean energy.



DIRECTION 1. ENERGY CONSERVATION, ENERGY EFFICIENCY, AND REDUCTION OF ENERGY DEMAND

It is the most realistic measure in the short term.



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The EU storage and demand scenarios without Russian gas imports

The most recent development of the European Commission focuses on avoided consumption.

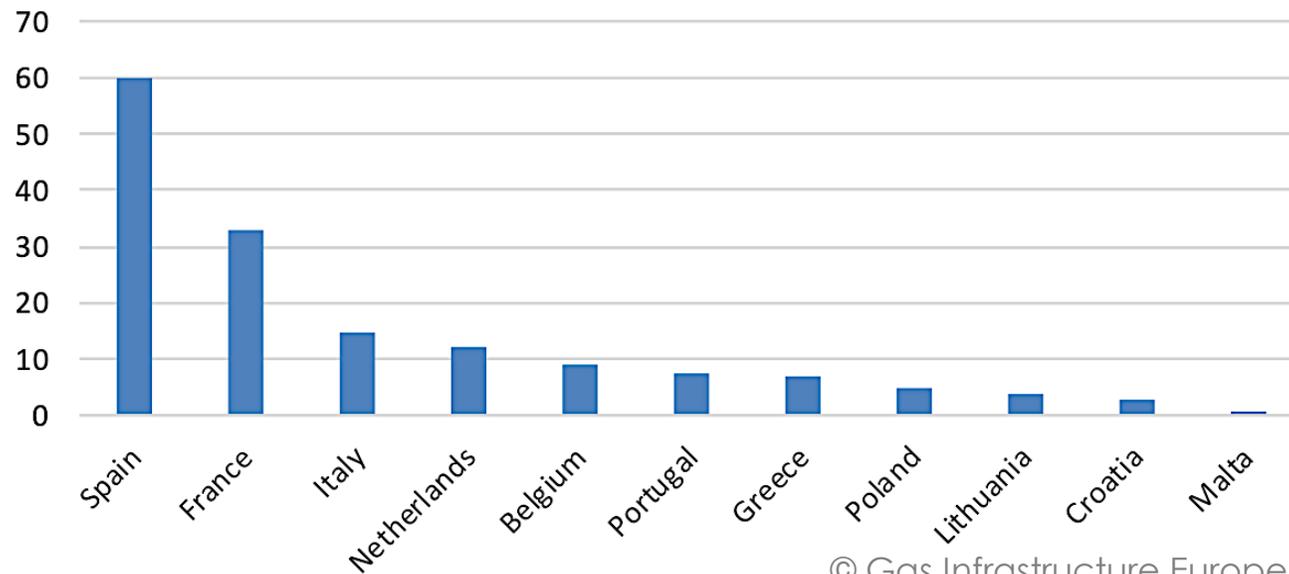
This approach is indicative of the fact that alternative supply options have now been more or less exhausted and in the event of total disconnection from Russian gas, the only way to avoid energy shortages in the EU this winter is through actions on the demand side.

DIRECTION 2. DIVERSIFICATION OF FUEL SUPPLIES AND ATTRACTION OF MORE RENEWABLE GAS SOURCES



Most of the measures are planned for five years, as their rapid implementation is problematic. Given the different volumes of Russian gas consumption and the capacity of LNG infrastructure, countries have different options for its replacement .

The energy crisis revealed the following problems of Europe's energy system:



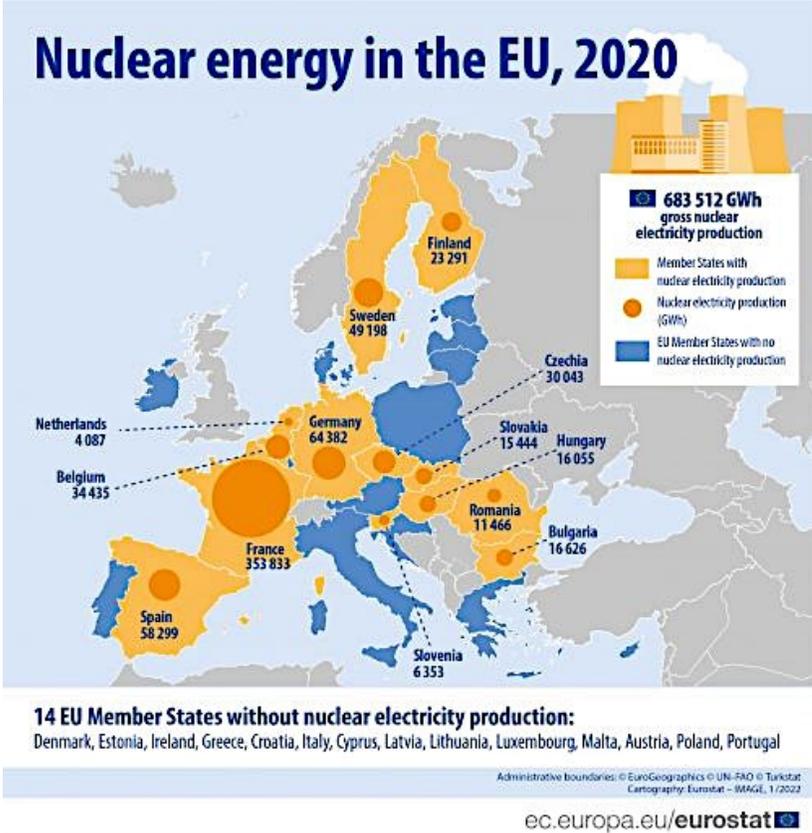
© Gas Infrastructure Europe
**Annual capacity of liquefied natural gas terminals,
billion cubic meters**

- ▶ limited gas transportation capacity;
- ▶ inadequate geographical location or insufficient length of gas pipelines;
- ▶ lack of LNG terminals and seaports in some countries;
- ▶ failure of the existing level of developing renewable energy to meet energy needs.

DIRECTION 3. ACCELERATED TRANSITION TO PRODUCTION AND USE OF CLEAN ENERGY



The most effective way to decarbonize the economy is direct electrification of end-use. 66% of the EU electricity has already been decarbonized, of which 50% is due to nuclear energy.



- ▶ **increasing the use of nuclear energy by EU countries is impossible.** The planned construction of 14 new reactors in Europe is not enough to prevent a gradual decline in the total installed capacity of existing reactors, which are nearing the end of their technical life. The new reactors will keep the share of nuclear energy in the structure of total energy production at 50% in 2035-2050;
- ▶ **increasing the use of renewable energy for a maximum is also impossible** considering the climate of the European region. However, as an additional source, it is planned to increase the use of biomass, wind, or solar energy from 32% to 40% of final energy consumption by 2030.

PROBLEMS ASSOCIATED WITH THE INTRODUCTION OF ECONOMIC SANCTIONS ON RUSSIAN FUEL



Current European energy strategy envisages the elimination of dependence on fossil fuels from Russia by at least 2030, which makes it impossible to impose a full embargo on energy imports from this country until then.

However, already at the beginning of September 2022, Russia announced the suspension of gas supplies to Europe for an indefinite period, and on September 28, due to an attack by an unknown party on the Nord Stream 1 and Nord Stream 2 gas pipelines, these supplies became practically impossible.

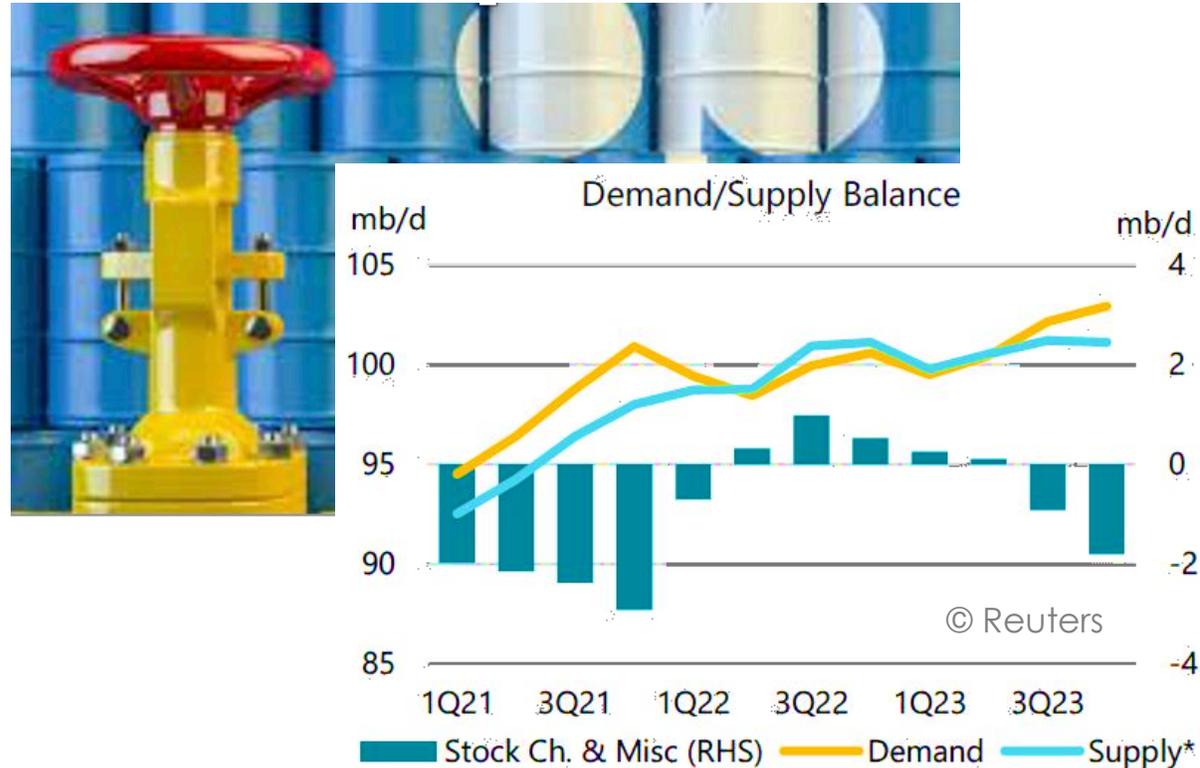


Thus, the further energy supply strategy for European countries will largely depend not only on economic, but also on geopolitical factors.

OIL SUPPLIERS ARE BEGINNING TO REVIEW THEIR STRATEGIES



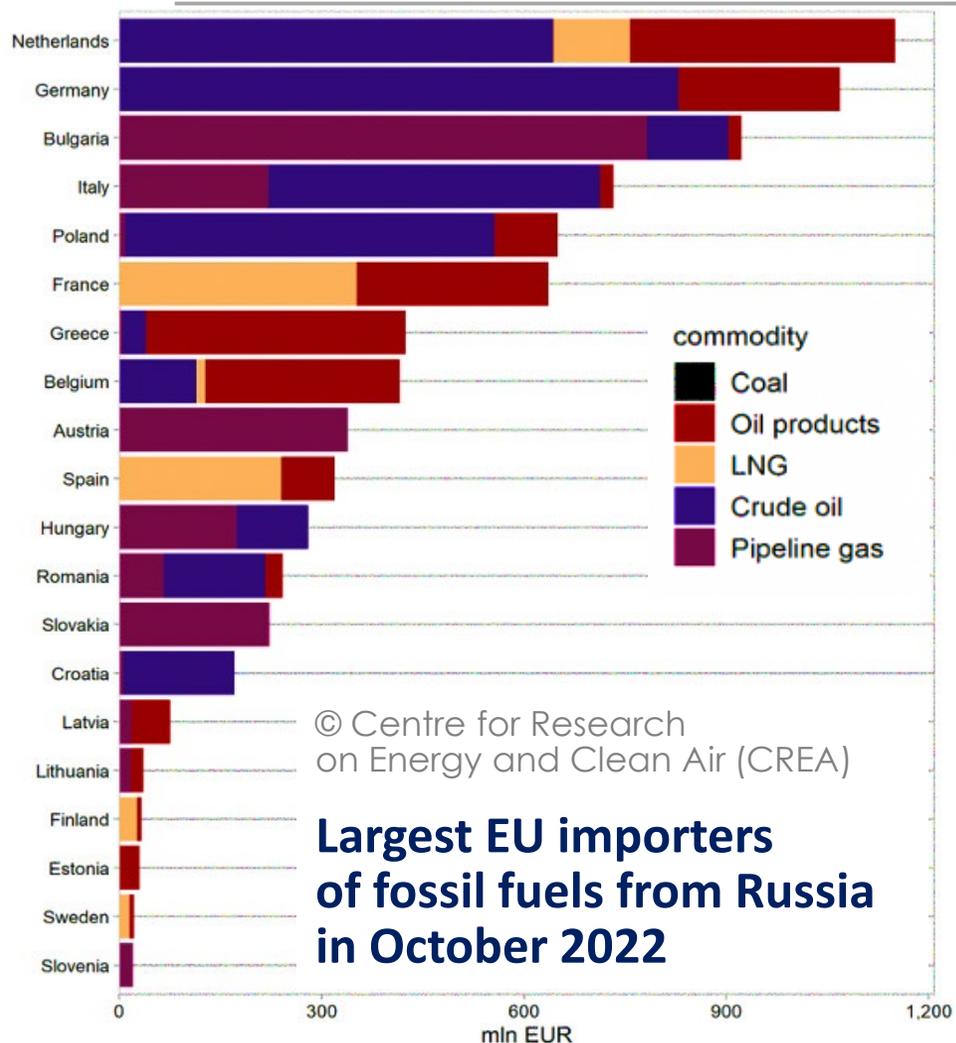
On October 5, 2022, at the 33rd meeting of the ministers of OPEC countries and non-OPEC partner countries decision was made to reduce total production by 2 million barrels per day compared to the levels as of August 2022, starting in November 2022.



Reasons:

- ▶ the recovery of global oil demand growth after the pandemic is slower than expected;
- ▶ the need to adjust the balance of oil supply and demand on the world market;
- ▶ the need to regulate oil prices;
- ▶ informal and tacit economic support of Russia.

THE DECISION TO REDUCE THE TOTAL OIL PRODUCTION BY THE OPEC+ COUNTRIES IS BENEFICIAL FOR RUSSIA



The decision of OPEC+ to reduce the total oil production is not critical for the general market:

- ▶ the quotas for oil production have not been fully used;
- ▶ the development of developed countries and China are slow downning;
- ▶ developed countries and China are trying to find additional opportunities to oil supply;
- ▶ the long-term excess of oil production over its consumption has formed significant reserves.

But it is beneficial for Russia, which will have the opportunity to increase its income from the export of fossil fuels and thus receive more money to finance the war against Ukraine.

THE COUNTRY'S ABILITY TO ABANDON RUSSIAN FOSSIL FUELS



The ability to abandon Russian fuels is determined by the country's energy system structure and state of development.

We have proposed a method of a quantitative assessment of the state of energy systems of countries in the form of an integrated Energy Freedom Index (Ief) which summarizes the following subindices:

- ▶ **Subindex of energy potential (Iep)** – determines the potential of the country in terms of access to fuel and energy resources, namely to reserves of coal, natural gas and oil;
- ▶ **Subindex of energy balance (Ieb)** – reflects the annual balance between total production and consumption of electricity and heat in the country;
- ▶ **Subindex of energy development (Ied)** – demonstrates the ability of the country's energy system to develop, increase energy efficiency and increase the capacity of electricity generation facilities, including from renewable sources.

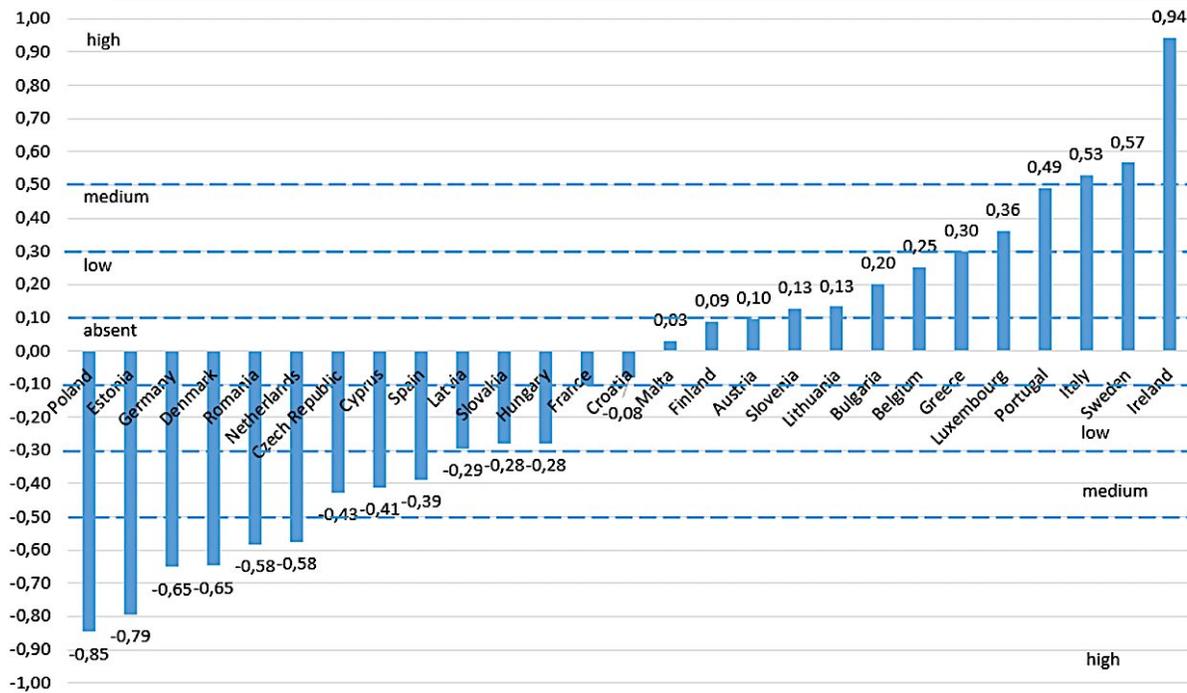
$$Ief = Iep \times Ieb \times Ied$$

RANKING OF THE EU COUNTRIES AND UKRAINE BY THE VALUE OF THE ENERGY FREEDOM INDEX (Ief)



Rank 2020	Country	Ief 2019	Ief 2020	Index components 2020			Share of imports from Russia in national consumption (Imrf)	Correlation between Ief and Imrf
				Iep	Ieb	Ied		
1	Ukraine	0,70	0,77	1,07	0,72	1,00	NA	NA
2	Bulgaria	0,59	0,76	1,00	0,69	1,11	0,40	0,20
3	Poland	0,58	0,63	1,05	0,59	1,01	0,37	-0,85
4	Denmark	0,70	0,61	0,95	0,98	0,65	0,16	-0,65
5	Czech Republic	0,55	0,59	1,00	0,63	0,94	0,24	-0,43
6	Sweden	0,68	0,59	0,94	0,63	1,00	0,08	0,57
7	Latvia	0,18	0,56	0,94	0,64	0,93	0,31	-0,29
8	Slovenia	0,47	0,55	0,97	0,55	1,03	0,10	0,10
9	France	0,48	0,54	0,94	0,58	0,99	0,09	-0,10
10	Romania	0,72	0,54	0,95	0,72	0,78	0,18	-0,58
11	Finland	0,42	0,49	0,94	0,52	1,00	0,45	0,09
12	Croatia	0,36	0,43	0,95	0,45	1,00	0,09	-0,08
13	Hungary	0,35	0,42	0,99	0,40	1,05	0,54	-0,28
14	Slovakia	0,32	0,40	0,95	0,41	1,03	0,60	-0,28
15	Germany	0,33	0,37	1,01	0,37	0,98	0,28	-0,65
16	Austria	0,35	0,32	0,94	0,42	0,82	0,03	0,10
17	Netherlands	0,39	0,32	0,95	0,35	0,95	0,55	-0,58
18	Portugal	0,23	0,31	0,94	0,35	0,94	0,05	0,49
19	Ireland	0,31	0,28	0,94	0,26	1,14	0,53	0,94
20	Greece	0,25	0,28	0,99	0,32	0,90	0,03	0,30
21	Spain	0,26	0,28	0,95	0,28	1,04	0,08	-0,39
22	Belgium	0,22	0,26	0,94	0,26	1,06	0,29	0,25
23	Italy	0,21	0,24	0,94	0,25	1,00	0,25	0,53
24	Lithuania	0,10	0,13	0,94	0,13	1,10	0,98	0,13
25	Estonia	0,18	0,10	0,94	0,11	1,01	0,16	-0,79
26	Luxembourg	0,03	0,05	0,94	0,05	1,00	0,03	0,36
27	Cyprus	0,04	0,05	0,94	0,05	1,03	0,05	-0,41
28	Malta	0,01	0,01	0,94	0,01	1,00	0,17	0,03

CORRELATION BETWEEN THE ENERGY FREEDOM INDEX (Ief) AND THE SHARE OF IMPORTS OF RUSSIAN FOSSIL FUELS IN THE STRUCTURE OF THEIR TOTAL CONSUMPTION (Imrf)



▶ countries with a high and medium density of the inverse relationship between their Ief and Imrf – **Poland, Estonia, Germany, Denmark, Romania, the Netherlands, the Czech Republic, Cyprus, and Spain;**

▶ countries with a low level of direct and inverse relationship between their Ief and Imrf – **Latvia, Slovakia, Hungary, Slovenia, Austria, Belgium, and Lithuania;**

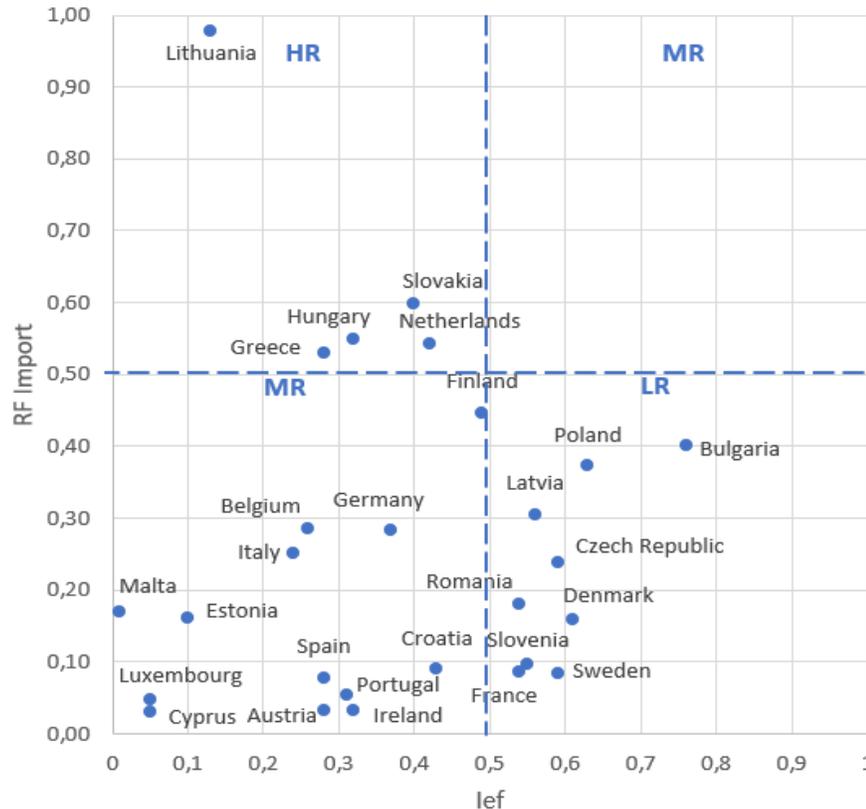
▶ countries for which the relationship between their Ief and Imrf has not been established – **Croatia, France, Malta, and Finland;**

▶ countries with a high and medium density of direct relationship between them Ief and Imrf – **Greece, Luxembourg, Portugal, Italy, Sweden, and Ireland.**

THE GROUPING OF COUNTRIES IN THE TWO-DIMENSIONAL FIELD OF PARAMETERS – I_{ef} AND I_{mrf}



- ▶ in the **high-risk zone (HR)** – countries, whose index is below average, and which have more than half of Russian fossil fuels in the structure of total consumption: $I_{ef} < 0,50$, $I_{mrf} > 0,50$ – **Greece, Lithuania, Netherlands, Slovakia, and Hungary;**



- ▶ in the **medium-risk zone (MR)** – countries whose index is below average, but which have less than half of Russian fossil fuels in the structure of total consumption: $I_{ef} < 0,50$, $I_{mrf} < 0,50$ – **Austria, Belgium, Estonia, Ireland, Spain, Italy, Cyprus, Luxembourg, Malta, Germany, Portugal, and Croatia;**
- ▶ in the **low-risk zone (LR)** – countries whose index is above average, and which have less than half of Russian fossil fuels in the structure of total consumption: $I_{ef} > 0,50$; $I_{mrf} < 0,50$ – **Bulgaria, Denmark, Latvia, Poland, Romania, Slovenia, France, Czech Republic, and Sweden.**

THE GROUPING OF COUNTRIES ACCORDING TO THE DEGREE OF THEIR READINESS TO REPLACE RUSSIAN FOSSIL FUELS AND IMPOSE AN EMBARGO



- ▶ **Group 1** – countries for which the refusal to import fossil fuels from Russia threatens the greatest losses in the economy, and which need and may receive a delay in the imposition of embargoes – **Czech Republic, Hungary, and Slovakia;**
- ▶ **Group 2** – countries that are heavily dependent on fuel imports from Russia, and at the beginning of the sixth package of sanctions have some controversy over the imposition of the embargo – **Austria, Germany, Netherlands, Romania, and France;**
- ▶ **Group 3** – countries that have significant or moderate dependence on fossil fuels imports from Russia, but support the embargo – **Belgium, Bulgaria, Croatia, Italy, Lithuania, Poland, and Finland;**
- ▶ **Group 4** – countries that have low dependence on fuel imports from Russia and support the embargo – **Cyprus, Denmark, Estonia, Greece, Ireland, Latvia, Luxembourg, Malta, Portugal, Norway, Slovenia, and Spain.**



LOSSES OF UKRAINE'S ECONOMY DUE TO THE WAR

Property types	Damages, \$ bln	Losses, \$ bln	Reconstruction and recovery needs, \$ bln
Housing	47,8	3,5	75,3
Transportation infrastructure	35,1	18,7	51,1
Industry and business services	9,7	30,3	19,7
Agri sector and land resources	4,3	23,4	17,5
Social services	0,2	6,4	6,6
Vehicles	2,7	0,4	5,0
Education	4,4	2,1	5,4
Commerce	2,1	23,3	3,9
Energy	1,8	11,6	3,5
Health care	1,6	2,7	2,5
Utilities	1,3	2,3	1,7
Culture, religion, sport, and tourism	2,0	4,3	3,2
Administrative buildings	0,9	0,1	1,3
Digital infrastructure	0,6	1,1	1,0
Financial sector	0,02	0,2	0,02
Total	114,5	130,4	197,8
Additional needs for demining (according to the WB preliminary assessment)			70
Total, with demining			267,8

Losses of the economy from damage of physical infrastructure since the beginning of hostilities (in case of complete destruction) as of 05.09.2022:

- ▶ The total economic losses have already exceeded USD 800,5 billion;
- ▶ The total amount of direct damage of infrastructure has already exceeded USD 130,4 billion;
- ▶ GDP is expected to shrink by 35-45%.

LOSSES OF THE ENERGY SECTOR OF UKRAINE



- ▶ **The total losses in the energy sector are estimated at more than USD 3 billion, of which more than a USD 1,1 billion has already been borne by the national nuclear power company Energoatom.**
- ▶ **Almost 650 000 consumers do not have access to electricity, and more than 180 000 households are without gas supply.**
- ▶ **Almost 5% of the installed generating capacities have been destroyed. 35% of generating capacity is now located in the occupied territories;**
- ▶ **Russian occupying forces captured Zaporizhzhya NPP, Kakhovska HPP, destroyed Okhtyrska CHPP;**
- ▶ **The renewable energy sector is damaged – more than 50% of thermal power, 30% of solar, and more than 90% of wind generation have been disabled.**

THE THREAT OF DESTRUCTION OF THE ZAPORIZHZHYA NUCLEAR POWER PLANT AS A RESULT OF MILITARY ACTIONS



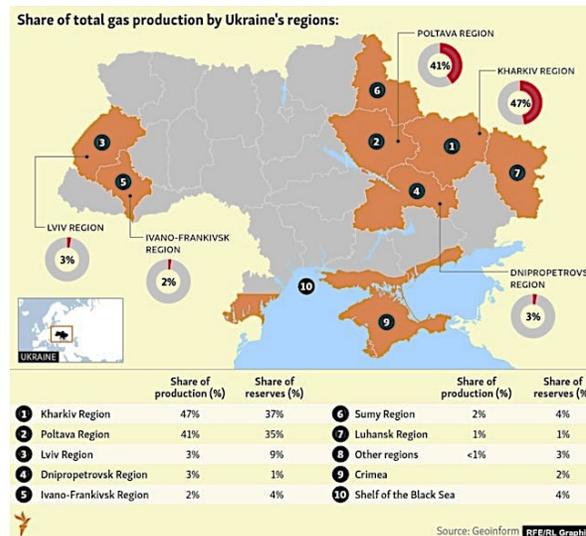
As a result of the accident at the Zaporizhzhya NPP, caused by Russia's military actions, radioactive pollution will affect not only Ukraine, but also the Black Sea, Moldova, Romania, Bulgaria and even Turkey. Under other weather conditions, radioactive emissions will move to the east.

At 350 km from the emission point, the level of Cesium-137 fallout can reach values like those on the outskirts of the Chernobyl exclusion zone.

LOSSES OF THE ENERGY SECTOR OF UKRAINE



- ▶ **Gas production fell by about 12-15%**
- ▶ Gazprom almost stopped the transit of gas through Ukrainian gas pipelines. In June, the monthly volume of gas transit through the Ukrainian GTS fell to 1.25 billion cubic meters from the 3.3 billion cubic meters of capacity booked at that time. This is 3-5 times less than what was transited on average per month during several previous years.



- ▶ **Stopping the transit will sharpen at least two threats. First, it is a shortage and rising gas prices on the western borders of Ukraine. Second, the disappearance of any safeguards for the "accidental" destruction of gas pipelines, due to which it may be impossible to transport domestically produced gas to the Right-bank regions of Ukraine.**

POSITIVE DEVELOPMENTS IN THE ENERGY SECTOR OF UKRAINE



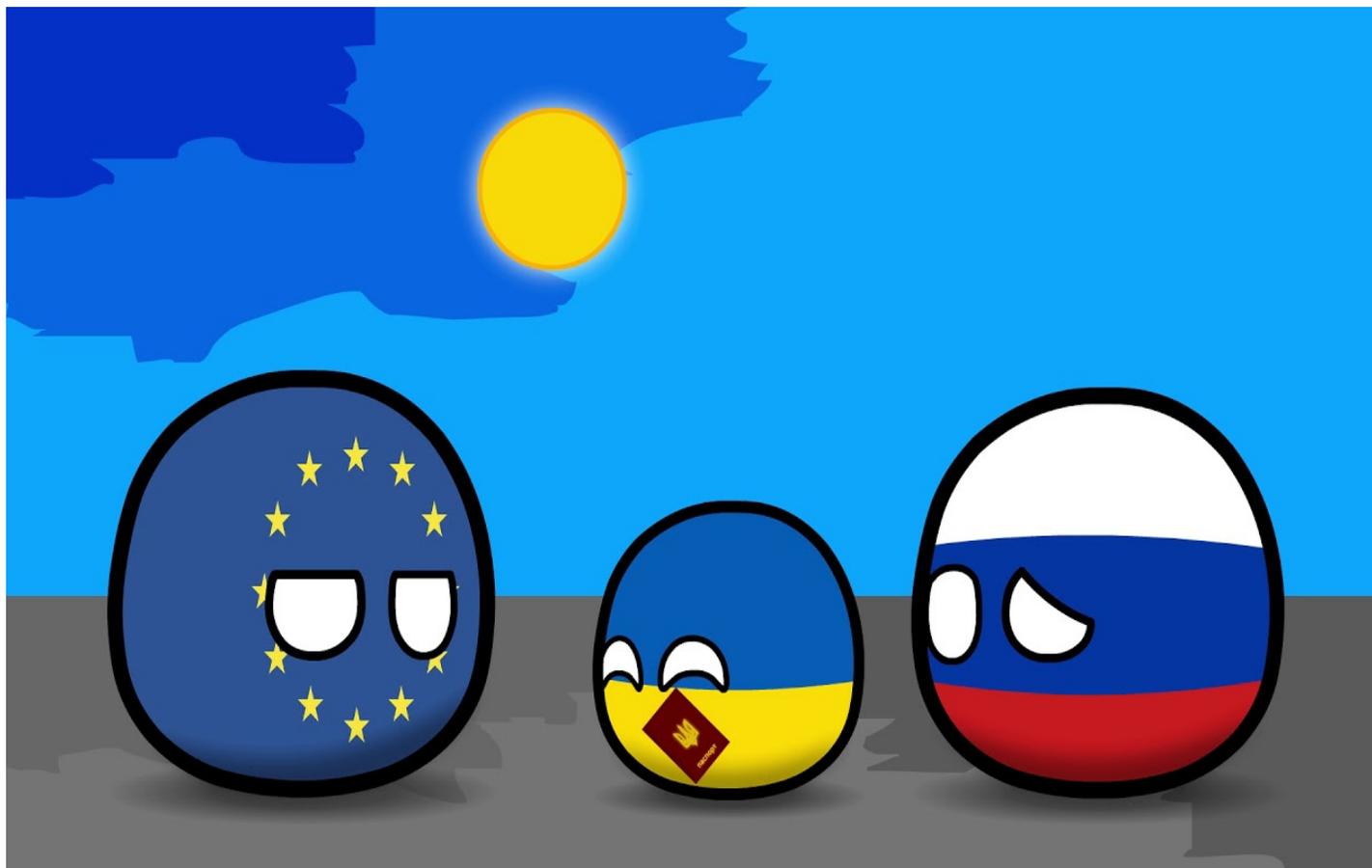
- ▶ **Energoatom and all its stations were transferred to the Paris Center of the World Association of Nuclear Operators (WANO). Until now, Ukrainian nuclear power plants were part of the Moscow center WANO.**
- ▶ Ukraine has refused to purchase Russian nuclear fuel. The current fuel reserves for WWER-1000 reactors will be enough for two years.
- ▶ During this period, it is planned to equip one of the Ukrainian enterprises with a production line for assembling Westinghouse fuel assemblies.

POSITIVE DEVELOPMENTS IN THE ENERGY SECTOR OF UKRAINE



- ▶ The Ukrainian power system has finally disconnected from the power systems of Russia and Belarus and joined the European Network of Transmission System Operators for Electricity (ENTSO-E). Export of electricity from Ukraine to Europe has begun.
- ▶ **Currently, export volumes have increased by 2.5 times, and Ukrainian electricity is supplied to Romania, Slovakia (125 MW each), Moldova (200 MW) and Poland (about 210 MW). After the implementation of additional technical measures, the capacity for the sale of electricity abroad may increase to 6 GW.**
- ▶ The possibility of using the national GTS for transporting hydrogen to Europe is also being studied. The conversion of the gas transportation network and hydrogen storage facilities will allow Ukraine to maintain its importance as a transit country of energy resources.

EU COUNTRIES WILL OVERCOME APPROACHING WINTER CHALLENGE FOR THE SAKE OF THE DEMOCRATIC FUTURE OF EUROPE



**THANK
YOU
FOR YOUR
ATTENTION!**