ENERGY INVOLVEMENT OF EXTERNAL ACTORS IN THE WAR IN UKRAINE

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ENERGY INVOLVEMENT OF EXTERNAL ACTORS IN THE WAR IN UKRAINE

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

Central European countries' support in ensuring the energy security of Ukraine during the war

- Russia's full-scale invasion of Ukraine in 2022 exposed the country to an acute energy crisis, targeting critical infrastructure and severing access to traditional supplies from Russia and Belarus. In this context, Central European countries, especially Poland, Romania, Slovakia, Hungary, Lithuania, and Czechia, played a decisive role in sustaining Ukraine's energy security and accelerating its structural reorientation toward the European energy system. Through a combination of logistical innovation, market coordination, and political support, these countries enabled Ukraine to rapidly reconstruct its energy import model. Within two years, Ukraine replaced over 90% of its pre-war fuel imports with supplies routed through Central Europe, using maritime terminals, regional refineries, and rail-truck corridors. Simultaneously, reverse-flow infrastructure allowed access to natural gas from the West, supported by EU LNG and US financial aid. Despite wartime disruptions, domestic gas production remained stable, further reducing dependence on external sources. Central European support extended beyond immediate supply. Emergency synchronisation with the ENTSO-E grid enabled electricity flows during crisis periods and marked the beginning of Ukraine's integration with the continental power system. Material assistance, regulatory cooperation, and technical training reinforced the resilience and modernisation of Ukraine's energy

sector. This regional partnership demonstrated not only solidarity but also strategic foresight. Central Europe, once itself dependent on Russian energy, has become a key enabler of Ukraine's energy sovereignty. In doing so, it reinforced regional stability, strengthened EU energy architecture, and contributed to the long-term deterrence of energy coercion in Europe.

International response tools to wartime challenges for energy security: Learning the lessons of Ukraine

- Russia's full-scale invasion of Ukraine has turned the country's energy sector into a critical test case for wartime resilience and regional energy security. Ukraine's early decisions to end dependence on Russian energy – ceasing natural gas imports, diversifying nuclear fuel, and synchronising with ENTSO-E – proved essential in withstanding systemic shocks. International support, coordinated largely through EU mechanisms, played a decisive role in sustaining Ukraine's energy system. Emergency fuel deliveries, equipment for infrastructure repair, legal assistance, and financial aid were mobilised rapidly. Initiatives like the Ukraine Energy Support Fund and the EU Civil Protection Mechanism enabled targeted, large-scale assistance. Despite repeated attacks, Ukraine maintained energy flows, expanded cross-border cooperation, and continued aligning with EU energy frameworks. It now contributes to European energy stability through electricity trade, natural gas transit, and the development of renewables, hydrogen, and biomethane. Its transition from a consumer to a strategic partner marks a shift in the regional energy landscape. The war also exposed the limits of current EU crisis tools, which are inadequate under wartime conditions. Market failures and uncoordinated national decisions disrupted energy flows. The Ukrainian experience highlights the need for dedicated wartime energy governance, shared regional reserves,

and the formal inclusion of third countries like Ukraine in EU crisis response mechanisms. Ukraine's case offers a model for strengthening European energy resilience through integration, coordination, and strategic foresight.

The EU and US energy response to the war in Ukraine

- In response to Russia's full-scale invasion of Ukraine in 2022, the European Union and the United States enacted a coordinated strategy targeting the Russian energy sector – historically a cornerstone of Moscow's economic power and geopolitical leverage. Sanctions focused primarily on reducing Russia's crude oil and natural gas revenues, curbing its influence over Europe's energy security, and accelerating the EU's green transition. The EU's efforts, grounded in pre-war regulatory frameworks and long-standing calls from Central and Eastern European countries, culminated in a phased embargo on Russian fossil fuels, including crude oil and coal, and a legislative plan to end natural gas imports by 2027. Complementing this, the US promoted price caps on Russian crude oil while expanding its own production and LNG exports to Europe. Although initial disruptions occurred, especially in diesel supplies and Ukraine's fuel needs, market adaptation was swift. Ukraine, despite ceasing Russian natural gas imports pre-invasion, lost its role as a natural gas transit country in 2025 – an outcome shaped by declining European demand and strategic decisions by EU institutions. Nevertheless, the Ukrainian transmission system remains operational, supported by EU-based reverse flows. Overall, sanctions did not provoke an energy crisis but instead reinforced EU-US cooperation, strengthened supply diversification, and intensified the shift toward renewables. The trajectory set by these measures positions both Europe and Ukraine for a more secure, decarbonised energy future, independent of Russian influence.

The energy commitment of external actors in the Ukraine war and the European Union's response

- Russia's invasion of Ukraine in 2022 marked the full-scale weaponisation of energy, exposing the European Union's strategic vulnerability. In response, the EU drastically reduced its reliance on Russian fossil fuels, cutting pipeline natural gas imports from 155 bcm in 2021 to below 25 bcm in 2025, and committed to a full phase-out by 2027. This shift accelerated LNG infrastructure expansion and supply diversification, notably toward the US, Norway, and Qatar. Despite progress, the EU faces persistent risks: dependency on Chinese critical materials, internal divisions over energy policy, and grid instability linked to renewable intermittency. The US has strengthened its regional influence via nuclear investments in Eastern Europe, while Russia pivots toward China and India – gaining limited relief from sanctions. Ukraine remains energy-fragile but geopolitically vital due to its transit role and resource base. Western aid is increasingly tied to future mineral access. The EU must now focus on decentralisation, market reform, and supply chain resilience to withstand ongoing hybrid threats and maintain its decarbonisation trajectory.

INTRODUCTION

The full-scale aggression of the Russian Federation against Ukraine, launched on 24 February 2022, constitutes a watershed moment for the international environment – particularly in the context of regional and energy security in Central Europe. While the conflict is primarily military in nature, its consequences extend far beyond the battlefield, affecting economic structures, critical infrastructure, and the global resource order. One of the defining dimensions of this war has been energy – both as a strategic asset and a tool of political leverage.

In contrast to earlier episodes of Russia-Ukraine rivalry – characterised mainly by political pressure, information warfare, and asymmetric actions – the 2022 invasion evolved into a high-intensity conventional armed conflict. Within this framework, energy resources and transmission infrastructure assumed a central role, not only as objects of strategic interest but also as instruments of warfare.

Russia's aggression contributed to the politicisation and militarisation of energy, which had traditionally been viewed primarily through the lens of economic and infrastructural considerations. In pursuit of its strategic objectives, the Russian Federation has consistently exploited energy dependencies as a means of projecting power and destabilising both Ukraine and Central European states. This has been manifested through long-term initiatives such as the construction of bypassing infrastructure (Nord Stream 1 and Nord Stream 2, also TurkStream), manipulation of supply volumes and commodity prices, as well as direct military actions – including the deliberate destruction of Ukraine's electricity and heating infrastructure.

In response, a wide array of external actors – including allied states, international organisations, financial institutions, and private sector entities – have mobilised

to support Ukraine not only militarily and humanitarianly but also in the energy domain. The scope of this support has been multifaceted, comprising emergency equipment deliveries for power grid repairs, technical assistance enabling synchronisation with the European ENTSO-E system, investment programs in renewable energy and energy efficiency, and legislative measures facilitating Ukraine's access to the EU energy market. A key element of this cooperation has been the provision of fossil fuels – particularly natural gas – through enhanced energy cooperation between Ukraine and Central European countries.

From a geostrategic perspective, these initiatives served a dual function: on the one hand, they acted as a counterbalance to Russian energy coercion; on the other, they catalysed processes aimed at strengthening Ukraine's energy sovereignty and integration with the Western energy market. The primary objective of this publication is to analyse the forms, scope, and implications of external actors' energy engagement in the context of the Russia-Ukraine war. The authors operate on the assumption that contemporary armed conflicts are multidimensional in nature and that a state's energy security must be examined in close connection with military, economic, technological, and informational factors. The analysis is structured around three main areas: (1) the instrumentalization of energy in warfare – by both the aggressor (Russia) and the defending party (Ukraine); (2) the responses and energy-related actions of external actors; and (3) the long-term implications of these developments for the European energy security system, with particular attention on Central Europe.

The publication is theoretically grounded in the paradigm of comprehensive security, which posits that a state's ability to ensure energy security during armed conflict depends on its internal infrastructural resilience, the extent of international support, and the adaptive capacity of its political and economic system. In this context, the Russia-Ukraine conflict serves as a unique research laboratory

for examining new forms of international energy solidarity, the transformation of critical infrastructure under military pressure, and the reconfiguration of global resource interdependencies – especially in light of the disintegration of energy ties with the Russian Federation.

Particular emphasis is placed on the role of third-party states – such as the United States and Norway – whose involvement in the energy sector affects not only the short-term stabilisation of the region but also the shaping of a new architecture of energy security on both regional and global scales. In an era of intensifying international instability and the growing fragmentation of the global energy market, the question of external actors' role in the reconstruction, transformation, and protection of critical infrastructure gains analytical, strategic, and normative significance. Ukraine – and more broadly, the countries of the Central European region – face numerous challenges, but also new opportunities arising from deepening cooperation with key external actors. Understanding and analysing these processes is of particular scholarly relevance, especially in the context of shaping the future framework of European energy security.

Michał Paszkowski
Lublin 2025

CENTRAL EUROPEAN COUNTRIES' SUPPORT IN ENSURING THE ENERGY SECURITY OF UKRAINE DURING THE WAR

Michał Paszkowski

Introduction

The Russian Federation's war against Ukraine, initiated on 24 February 2022, has triggered not only a humanitarian and political catastrophe but also a profound, systemic energy crisis in Central Europe. Alongside its military aggression, Russia has implemented a strategy of energy destabilisation through deliberate and repeated missile and drone attacks on Ukraine's power, natural gas, and fuel infrastructure. These assaults aimed not only to destroy critical elements of the energy system – such as power plants, transformer stations, fuel depots, and pipelines – but also to break societal morale by causing widespread and prolonged power, heat, and fuel outages, especially during winter.

Before the full-scale invasion, Ukraine was heavily reliant on energy and fuel supplies from the east, notably from Russia and Belarus. Approximately 60% of liquid fuels consumed in 2021 originated from these two countries, and a significant portion of natural gas – despite declining direct imports – entered the Ukrainian market via transit

systems and intermediaries. The onset of war demanded an immediate and profound reconfiguration of these supply structures. With only one operational refinery before the conflict, Ukraine was forced to seek new sources and channels for energy and fuel procurement[1].

In this critical context, Central European countries – particularly Poland, Romania, Slovakia, Hungary, Czechia, and Lithuania – played a fundamental role in ensuring Ukraine's energy security. Their multifaceted support spanned three essential areas: liquid fuels, natural gas, and electricity. In the liquid fuel sector (gasoline, diesel, LPG), Poland and Romania became primary conduits, supplying products from European refineries or via maritime imports from third countries, including the United States and the Middle East. Regarding natural gas, Ukraine gained access to reverse-flow transmission connections through cooperation with Slovakia, Hungary, and Poland, while benefiting indirectly from US LNG deliveries via terminals in Świnoujście and Klaipėda. Finally, in the electricity sector, regional states facilitated Ukraine's emergency synchronisation with the continental ENTSO E grid and supplied equipment, technology, and power during the peak crisis in winter 2022–2023.

These efforts were enabled by pre-existing transmission infrastructure, swiftly adapted legal frameworks, political support, and coordination at EU and regional levels. Central European countries, which had recently themselves depended on Russian energy resources, demonstrated the capacity for solidarity and strategic energy policy reorientation in the face of geopolitical threats. Their assistance to Ukraine transcended national security, contributing tangibly to European energy resilience and structural transformation in the region. This article aims to highlight the nature, scope,

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1 M. Paszkowski, *War in Ukraine: Kyiv's efforts to ensure the availability of petroleum products*, "IES Commentaries" 2024, no. 78 (1103), https://ies.lublin.pl/en/comments/war-in-ukraine-kievs-efforts-to-ensure-the-availability-of-petroleum-products/ [18.07.2025].

and significance of these actions across the three critical energy sectors in both regional and European contexts.

Logistical innovations in fuel deliveries to wartime Ukraine

Russia's invasion in February 2022 radically transformed Ukraine's energy landscape. Particularly urgent was the need to restructure liquid fuel supply chains comprising gasoline, diesel, and LPG. In 2021, approximately 62% of diesel imports and 50% of gasoline imports came from Russia and Belarus, with Belarus supplying 45% of diesel and 40% of gasoline, and Russia contributing around 17% of diesel and 10% of LPG. When Russia ceased deliveries, and Belarus, aligned with Moscow, also ended its exports, Ukraine was compelled to rapidly develop an alternative logistical and commercial infrastructure.

Central European countries – Poland, Lithuania, Romania, Hungary, and Slovakia – played key roles in this transformation. They not only opened their logistical infrastructure but actively reconfigured regional trade routes. Poland emerged as a pivotal logistics hub: its Gdańsk fuel terminal, domestic refineries, and border rail terminals (Dorohusk, Hrubieszów, Medyka) allowed for diversified import avenues. The expansion of port throughput enabled Poland to receive fuel imports from third countries. In 2022, over 1.27 million tonnes of fuel passed through Poland enroute to Ukraine, rising to over 1.76 million tonnes in 2023[2]. ORLEN established dedicated "logistics corridors" to accelerate freight and trucking routes, reducing transit times to 48–72 hours. Regulatory support – customs streamlining, ADR exemptions, and increased rail capacity – facilitated operations, coupled with political

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[2] S. Matuszak, *A key partner. Ukraine–EU trade in 2023*, 4 March 2024, https://www.osw.waw.pl/pl/publikacje/analizy/2024-03-04/kluczowy-partner-handel-ukraina-ue-w-2023-roku [21.07.2025].

coordination with the European Commission, NATO, and EU institutions. Lithuania, despite its smaller capacity, made significant contributions to the northern fuel corridor. The Klaipėda terminal, operated by Klaipėdos Nafta, enabled maritime imports from Norway, Finland, and the US. Liquid fuels then moved by rail via Poland into Ukraine. ORLEN Lietuva's Możejki refinery – the sole operating refinery in the Baltics – supplied refined products for transit. In 2023, Lithuania exported 300 thousand tonnes of fuel to Ukraine, a 45% increase over 2021, and the government subsidised the logistic costs and waived terminal fees. Romania served southern Ukraine through the port of Constanța and the Danube terminals in Galați, Tulcea, and Brăila, forming major transhipment points for Middle Eastern fuel imports[3]. It also developed temporary terminals and accelerated clearance digitalisation. Hungary, despite a cautious political stance on the war, supported fuel deliveries through MOL's operations. MOL's Százhalombatta refinery increased gasoline and diesel production for Ukraine. Hungarian exports exceeded 300 thousand tonnes in 2023 – twice the volume of 2021 – though transport corridors were limited, and coordination with EU corridors remained incomplete. Nonetheless, MOL's infrastructure provided a stabilizing effect. Slovakia's Slovnaft refinery in Bratislava, under MOL's control, exported over 400 thousand tonnes of fuels year-round. Diesel, gasoline, and LPG were transported by rail and tanker via border crossings at Uzhhorod, Chop, and Maťovce. Slovakia also actively participated in the EU's "Solidarity Lanes" initiative, enhancing cross-border infrastructure and customs for strategic goods, including fuels[4].

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3 B. Popov, *Ukraine's Strategic Interests in Romania*, 19 May 2025, https://thegaze.media/news/ukraines-strategic-interests-in-romania [20.07.2025].

4 European Commission, *EU–Ukraine Solidarity Lanes*, https://commission.europa.eu/topics/eu-solidarity-ukraine/eu-assistance-ukraine/eu-ukraine-solidarity-lanes_en [20.06.2025].

Within two years of the invasion, Ukraine had fully restructured its liquid fuel import system from approximately 70% eastern-sourced in 2021, to over 92% of imports in 2023 originating from the West – chiefly from Poland, Romania, Slovakia, Lithuania, and maritime imports via these countries. According to Ukraine's State Statistics Service, diesel imports in 2023 totalled 3.4 million tonnes, with distribution as follows: 1.2 million tonnes from Poland, 700 thousand from Romania, 500 thousand from Slovakia, and 300 thousand each from Hungary and Lithuania.

This multi-directional logistical framework, consisting of marine import terminals, regional refineries, and rail and trucking infrastructure, not only secured supply continuity but also reduced vulnerability to energy blackmail. Intergovernmental coordination, enhanced by the European Commission, proved pivotal in synchronising infrastructure and regulatory adaptation.

In summary, the Russia-Ukraine war catalysed regional energy-logistics integration in Central Europe. Poland, Lithuania, Romania, Hungary, and Slovakia not only replaced lost supply routes but also established a more diversified and resilient system. This represents a lasting geopolitical shift of Ukraine toward the West, both infrastructural and energetically, embedding the new fuel logistics network within a broader regional security framework.

Efforts to maintain Ukraine's access to natural gas in wartime

Following Russia's invasion in February 2022, Ukraine faced severe challenges in securing natural gas supplies. Prior to the war, Ukraine served as a major transit corridor for Russian gas to the EU while remaining heavily dependent on eastern imports. In 2013, over 90% of Ukraine's natural gas consumption, exceeding 25 bcm annually, originated from Russia. Post-Crimea occupation in 2014, Ukraine began reducing reliance on Russia, developing reverse-flow

infrastructure from Slovakia, Hungary, and Poland. However, until 2021, Ukraine's gas system remained hardware-linked to Russian infrastructure and susceptible to Gazprom's political pressure.

Ukraine completely stopped importing natural gas from Russia in 2016[5]. Domestic production became a crucial stabilising force: in 2021, Ukraine produced approximately 19.8 bcm, covering over 70% of domestic consumption. Despite military hostilities affecting extraction regions, production remained at 18.5 bcm in 2022 and rose to about 19.1 bcm in 2023, trending upwards. Natural gas reservoirs are concentrated in the Dnipro-Donbas region, western Ukraine, and the Subcarpathians. Ukrgazvydobuvannya, Ukraine's largest domestic producer and a Naftogaz subsidiary, undertook major wartime measures, including relocating infrastructure from frontline areas, enhancing facility protection, and drilling in safer zones[6]. In 2023, 86 new wells were drilled, some utilising development technologies provided by partners in the USA and Canada.

Domestic supply has become a strategic buffer, reducing import needs to approximately 5–6 bcm annually within a total consumption of 24–25 bcm (2023 data), meaning that over 75% of natural gas demand is met domestically. Consequently, Ukraine could sustain heating, industrial, and critical infrastructure sectors without resorting to high-risk spot market purchases. Policy measures – such as an export ban and directing surplus into strategic reserves – have further fortified domestic supply.

International cooperation supplemented domestic efforts. Slovakia remained Ukraine's most crucial gas supplier via reverse-flow – over 2.2 bcm in 2022 and 3.8 bcm

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5 M. Koczan, *Relacje gazowe Ukrainy z Rosją – próba zmiany modelu*, "Wschodnioznawstwo" 2019, vol. 13, p. 280.

6 Y. Prots, *Ukraine's Naftogaz brings new high-yield gas well online as country reserves run low*, 8 July 2025, https://kyivindependent.com/ukraines-naftogaz-brings-new-high-yield-gas-well-online-06-2025/ [10.07.2025].

in 2023. Poland, via LNG from Świnoujście and the Hermanowice-Drozdowicze route, contributed approximately 1.1 bcm in 2023. Hungary enabled technical transits of around 0.9 bcm. Romania and Czechia played supporting roles in regional redistribution and potential integration into Europe's broader gas-security network.

The United States also made vital contributions. As Europe's largest LNG provider, the US directed over 2.3 billion USD in energy aid to Ukraine[7], with approximately 800 million USD allocated for natural gas purchases. Programs from USAID and the US Department of Energy – such as credit guarantees and financing mechanisms – assisted Naftogaz in acquiring natural gas on European markets without burdening Ukraine's budget.

In summary, despite war-induced pressures, Ukraine maintained gas-sector stability by ensuring supply for civilians, industry, and defence. Over 75% domestic production, a flexible import infrastructure, and international support created a resilient system resistant to energy coercion and wartime threats. While Central European partnerships and US aid were essential, it was Ukraine's continued and ramped-up production capacity that underpinned its energy security.

Support for Ukraine's power-electricity system from Central Europe

Following Russia's full-scale invasion in February 2022, Central European countries played a critical role in Ukraine's access to electric power – with emergency aid and through long-term structural integration. In March 2022, just three weeks into the conflict, Ukraine's electricity grid was

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7 E. Watson, *US to announce $2.3 billion in military assistance for Ukraine*, 2 July 2024, https://www.cbsnews.com/news/u-s-2-3-billion-in-military-assistance-for-ukraine/ [15.07.2025].

emergency-synchronised with the continental ENTSO-E network[8]. Originally scheduled for 2023, the integration was expedited under crisis conditions through the combined efforts of transmission system operators from Poland (PSE), Slovakia (SEPS), Romania (Transelectrica), Hungary (MAVIR), and Lithuania (Litgrid), coordinated by the European Commission. The connection enabled both energy exports during surplus periods and imports amid intense Russian attacks on critical infrastructure in the autumn of 2022 and the winter of 2023. Cross-border electricity imports exceeded 2.5 TWh in 2023, bolstered by upgraded transmission lines linking Poland, Slovakia, and Romania.

Concurrently, these countries actively supported the rehabilitation and operational resilience of Ukraine's grid. Poland, Czechia, Romania, Lithuania, and Slovakia supplied tens of thousands of tonnes of technical equipment – transformers, cables, power generators, container substations, and switching gear. Poland delivered over 1,500 generators, and Lithuania sent advanced mobile power stations for the rapid restoration of service. This aid was coordinated via the EU Civil Protection Mechanism (UCPM) and the rescEU platform. Technical expertise was also provided to Ukrainian entities such as Ukrenergo and the National Energy and Utilities Regulatory Commission (NEURC), featuring contributions from Polish and Slovak experts in grid reconstruction planning and energy market design.

The collaboration also extended to structural investments. With backing from the European Commission, Central European countries engaged in developing distributed renewables and energy-storage projects in western Ukraine – regions relatively safer and better connected to the EU grid. In 2023, Poland, Slovakia, and Romania initiated planning

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8 ENTSO-E, *Continental Europe successful synchronisation with Ukraine and Moldova power systems*, 16 March 2022, https://www.entsoe.eu/news/2022/03/16/continental-europe-successful-synchronisation-with-ukraine-and-moldova-power-systems/ [25.06.2025].

for energy clusters comprising solar installations and battery storage with Ukrainian partners; Czechia financed photovoltaic systems for community infrastructure. Lithuania and Hungary organised training programs for Ukrainian specialists focusing on smart grids and energy efficiency, fortifying Ukraine's capacity for independent energy reconstruction. These efforts aligned with the European Council's December 2023 commitment to fully open the EU energy market to Ukraine in line with accession plans.

Simultaneously, an intensive legislative harmonisation process unfolded. As a state associated with the EU's Energy Community, Ukraine joined the energy market monitoring mechanisms and began cooperation between its own regulator and ACER and CEER. Central European nations, particularly Poland and Slovakia, transferred their expertise in day-ahead markets, balancing mechanisms, and cross-border capacity auctions (JAO). Strategies for implementing capacity markets and prosumer programs were designed following EU models.

In conclusion, the partnership between Central European states and Ukraine in the power sector has evolved beyond emergency support toward strategic cooperation encompassing infrastructural, market, and regulatory integration. Ukraine became part of the continental electricity system and benefited from support aimed at establishing a more resilient, decentralised, and sustainable energy sector. Central Europe's role as neighbour, technical partner, and EU policy intermediary remains indispensable to Ukraine's energy security and the stability of the wider region.

Conclusions

Since 2022, Russia's war against Ukraine has precipitated a deep energy crisis, with attacks on fuel, power, and natural gas infrastructure forcing a fundamental overhaul of the country's supply models. Central European countries, especially Poland, Romania, Lithuania, Slovakia, Hungary,

and Czechia, played a central role in constructing new fuel and natural gas supply systems and in executing emergency synchronisation of Ukraine's power grid with the EU.

A multi-tiered and diversified fuel import infrastructure has been established, leveraging maritime terminals, regional refineries, and rail-truck transit corridors. In the natural gas sector, Ukraine eliminated its reliance on Russian imports, shifting to domestic production and reverse-flow imports, supported by LNG from the EU, with coordinated frameworks such as the European Commission's "Solidarity Lanes". In electricity, emergency synchronisation with ENTSO-E was a transformative milestone. The support from Central European countries enabled Ukraine to weather winter energy crises and solidified its long-term strategic alignment with Europe's energy architecture. This assistance forms part of a broader effort to enhance regional resilience and solidarity amid Russian aggression.

INTERNATIONAL RESPONSE TOOLS TO WARTIME CHALLENGES FOR ENERGY SECURITY: LEARNING THE LESSONS OF UKRAINE

Oleksandr Sukhodolia

Introduction

The Ukrainian energy sector has traditionally been one of the largest in Europe, with its development objectives aligned with the European Union's energy policy priorities, emphasising low-carbon, affordable, and secure energy solutions. At the same time, recognising the threat posed by Russia's potential use of energy as a geopolitical weapon[1], Ukraine undertook measures to eliminate its dependence on its aggressive neighbour.

In 2015, Ukraine ceased purchasing natural gas from Russia, diversified its sources of nuclear fuel for nuclear power plants, achieved significant progress in integrating its gas transmission system into European networks, and successfully completed the synchronisation of its power system with the European Network of Transmission System Operators for Electricity (ENTSO-E).

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1 O. Sukhodolia, *Energy Weapon in a Geopolitical Strategy of Russia*, Kyiv 2020, https://niss.gov.ua/sites/default/files/2020-12/energy-weapon-english-dopovid_0.pdf [14.06.2025].

The full-scale Russian aggression against Ukraine has only reaffirmed the strategic soundness of these decisions. International support – ranging from the provision of means to protect critical energy infrastructure from Russian attacks to the supply of energy resources and spare parts for the repair of damaged equipment – has played a crucial role in sustaining the functionality of Ukraine's energy system. The resilience demonstrated by Ukraine during wartime underscores its capacity to contribute meaningfully to the security architecture of Central Europe.

The pre-war EU-Ukraine energy cooperation

EU-Ukraine energy relations are grounded in the Association Agreement[2], particularly Annex XXVII, which finalises long-standing mutual efforts to establish a strategic energy partnership and outlines the pathway toward full integration of the Ukrainian and EU energy markets. In both the electricity and natural gas sectors, Ukraine has implemented measures to prepare its energy systems for future unification with EU networks.

Ukrainian institutions have become members or observers of most European energy-related international bodies. In June 2017, the Ukrainian transmission system operator (TSO), NEC "Ukrenergo", signed the Agreement on the Conditions for the Future Interconnection of the Power Systems of Ukraine and Moldova with the Continental European Synchronous Area with ENTSO-E. In April 2020, the Ukrainian natural gas TSO, GTS Operator of Ukraine LLC, became an observer member of the European Network of Transmission System Operators for Gas (ENTSO-G). In November 2020, the State Nuclear Regulatory Inspectorate

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[2] European Union, *Association Agreement between the European Union and its Member States, of the one part, and Ukraine, of the other part*, 1 December 2023, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2014.161.01.0003.01.ENG [20.06.2025].

of Ukraine obtained observer status in the European Nuclear Safety Regulators Group (ENSREG). Additionally, a Memorandum of Understanding on a Strategic Energy Partnership between Ukraine and the EU was signed. As of 1 January 2024, NEC "Ukrenergo" attained full membership in ENTSO-E, marking the formal completion of the synchronisation process between the Ukrainian and EU power systems.

These efforts, supported by EU institutions, member states, and energy companies, became integral to Ukraine's strategic preparedness in the face of Russian aggression. Hours before the full-scale invasion, Ukraine disconnected its power system from the Russian grid to conduct tests required for synchronisation with ENTSO-E. After demonstrating the ability to operate in "island mode," Ukraine's power system was successfully synchronized with the European grid on 16 March 2022.

Starting in June 2022, and prior to the onset of large-scale Russian attacks on Ukraine's energy infrastructure, Ukraine began exporting electricity to EU countries, contributing to price stabilization in European markets. Following the destruction of a significant share of its energy facilities, Ukraine gained the technical capability to import electricity from the EU – a mechanism that proved vital after Russian strikes damaged up to 60% of Ukraine's energy infrastructure.

Since 2015, Ukraine has ceased natural gas imports from Russia, instead fostering trade relations with European partners. Ukraine's natural gas infrastructure has become integrated into the EU natural gas markets, with the implementation of EU legislation opening its domestic market to European companies. Ukraine has secured key agreements with EU partners to reserve cross-border capacities for natural gas imports. Agreements with Slovak, Polish, and Hungarian TSOs have enabled Ukraine to receive natural gas supplies via EU LNG terminals. This cooperation has proven mutually beneficial: Ukraine

achieved diversification of its natural gas sources, while international partners gained access to Ukraine's extensive underground natural gas storage facilities – the largest in Europe.

External support to keep Ukrainian energy sector functional in a war-time

During the full-scale Russian invasion, Ukraine's energy sector became the primary target due to its strategic importance for the national economy and essential public services. Since October 2022, Russia has launched over 1,000 attacks on Ukraine's energy infrastructure.

The crude oil refining industry was almost completely destroyed during the initial months of the war, with all crude oil refineries and most storage facilities rendered inoperative. This led to severe logistical disruptions in liquid fuels supply. Centralised heating infrastructure sustained damage in numerous cities near active combat zones, while shelling of regional natural gas distribution stations and networks further compromised energy delivery, interrupting supply to millions of consumers.

As a result, the available capacity of thermal power plants (TPPs) and combined heat and power plants (CHPs) has fallen to less than 20% of pre-war levels. Similarly, the operational capacity of the hydropower sector has decreased by approximately 50%. Nearly half of Ukraine's high-voltage transmission substations have also suffered critical damage. On average, 3.8 million consumers experienced power outages, while at the peak of system-wide disruptions, up to 13.5 million were left without electricity. In February 2025, following extensive missile strikes on natural gas production infrastructure, Ukraine's largest natural gas producer lost nearly 50% of its production capacity. In the face of these challenges and limited domestic resources, Ukraine has actively sought support from the international community for infrastructure repair and

energy supply restoration. Immediately after the attacks on crude oil refineries and depots, the European Commission distributed Ukraine's urgent requests for diesel, petroleum, and jet fuel to EU Member States. Many countries and energy companies responded by supplying liquid fuels.

At the initiative of the EU Commissioner for Energy, the Energy Community established the Ukraine Energy Support Fund[3] to coordinate international aid aimed at restoring Ukraine's damaged energy infrastructure. The Ukraine Support Task Force (USTF), established by the Secretariat, has been supporting Ukraine by coordinating the deliveries of specialised strategic equipment for the energy sector to repair infrastructure damaged during the war. As of April 2025, declared contributions to the Fund reached 1.15 billion EUR, involving 33 donors from 22 countries, including governments, private sector actors, and international institutions. Approximately 140 Ukrainian energy companies across the country have received aid. Ukraine received 1,761 humanitarian cargoes weighing 22.6 thousand tonnes from 38 countries[4].

The EU activated additional support mechanisms to ensure the stable operation of Ukraine's energy system[5]. The Energy Community Secretariat launched the Ukraine Legal Support Platform[6], enabling law firms to offer pro bono legal assistance to Ukrainian companies pursuing claims against

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3 Energy Community Secretariat, *Ukraine Energy Support Fund*, https://www.energy-community.org/Ukraine/Fund.html [10.07.2025].

4 Ukraine Government Portal, *Anti-Crisis Energy Headquarters reviews preparations for the heating season and needs of energy companies*, 30 April 2025, https://www.kmu.gov.ua/en/news/antykryzovyi-enerhetychnyi-shtab-rozghlianuv-pidhotovku-do-opaliuvalnoho-sezonu-ta-potreby-enerhetychnykh-pidpryiemstv [15.06.2025].

5 European Commission, *President von der Leyen announces new EU support for Ukraine's energy security for the winter*, 19 September 2024, https://enlargement.ec.europa.eu/news/president-von-der-leyen-announces-new-eu-support-ukraines-energy-security-winter-2024-09-19_en [25.06.2025].

6 Energy Community Secretariat, *Ukraine support*, https://www.energy-community.org/Ukraine/platform.html [10.06.2025].

the Russian Federation in national courts and under international arbitration. Several Ukrainian firms have already initiated investment arbitration proceedings.

The EU Civil Protection Mechanism has delivered over 8,800 power generators to Ukraine. The European Bank for Reconstruction and Development (EBRD) provided 50 million EUR in emergency liquidity to NEC "Ukrenergo" to stabilize the electricity grid. The EU also supports Ukraine in procuring natural gas, particularly through the Ukraine Facility, in cooperation with partner countries[7].

International assistance has extended to enhancing the physical protection of Ukraine's energy infrastructure. Security and resilience concerns are now reflected in bilateral security cooperation agreements with partner states. With the support of the UK and the USA, Ukraine has developed multi-level engineering and technical protection systems for energy facilities. These protection efforts are regularly discussed with partner governments both bilaterally and through multilateral platforms such as the NATO-initiated Ramstein format. Ukraine has received a variety of missile defence systems, aircraft, and other assets, enabling the development of a multi-layered defence system that has substantially reduced the proportion of successful strikes on energy facilities.

Long-term resilience measures have been integrated into the EU's Ukraine Facility, a comprehensive support program offering up to 50 billion EUR in grants and loans for 2024–2027. This funding will support Ukraine's stabilisation, recovery, and modernisation efforts, including the reconstruction and European alignment of its energy infrastructure. Within the Ukraine Facility, a Ukraine Investment Framework has been created to attract public and private

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[7] European Commission, *Commission steps up support for Ukraine's energy security and paves the way for full market integration*, 24 February 2025, https://ec.europa.eu/commission/presscorner/detail/en/ip_25_588 [19.06.2025].

investment, backed by 7.8 billion EUR in loan guarantees and 1.5 billion EUR in blended finance grants[8]. The European Investment Bank (EIB) has played a central role in funding energy grid restoration projects. In October 2024, the EIB adopted the Ukraine Energy Rescue Plan, guaranteed under the Ukraine Facility, which foresees up to 600 million EUR in financing for emergency energy projects across both public and private sectors[9]. In addition, countries such as the United Kingdom have launched specialised support initiatives. The Innovate Ukraine program aims to accelerate Ukraine's energy recovery, decarbonisation, and long-term energy security.

Ukraine's energy sector for future regional energy security

The resilience demonstrated by Ukraine during the full-scale war[10] underscores its emerging role as a key contributor to Central European security, particularly in the energy domain. Since synchronizing its power system with ENTSO-E, Ukraine has strengthened cross-border cooperation with neighbouring countries, including the restoration of transmission lines and the expansion of technical capacities for electricity exchange. In May 2023, the interstate power transmission line connecting the Khmelnytskyi Nuclear Power Plant (NPP) in western Ukraine with Rzeszów

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8 European Commission, *Ukraine*, https://enlargement.ec.europa.eu/european-neighbourhood-policy/countries-region/ukraine_en [27.06.2025].

9 European Investment Bank, *Energy rescue plan approved to finance EU-backed emergency heating and power projects for Ukraine ahead of winter season*, 8 October 2024, https://www.eib.org/en/press/all/2024-363-energy-rescue-plan-approved-to-finance-eu-backed-emergency-heating-and-power-projects-for-ukraine-ahead-of-winter-season [20.07.2025].

10 O. Sukhodolia, *Ukrainian Energy Sector under Military Attack: Lessons for Resilience*, [in:] T. Jermalavičius (ed.), *War and Energy Security: Lessons for the Future*, Tallin 2023, p. 78.

in southeastern Poland was restored and commissioned. By 2024, Ukraine was able to import up to 1.7 GW of electricity from the EU, with a current technical capacity of 2.1 GW, and plans for further interconnector expansion. Ukraine's wartime experience has also validated the importance of distributed generation as a key resilience tool. As a result, strategic policy decisions have been made to develop local energy resilience plans and decentralised generation, supported by economic incentives.

Technical integration with the EU energy system also enables Ukraine to unlock its vast potential for renewables development. With considerable capacity in hydropower, biomass, and agro-based renewables, Ukraine is positioned to become a key provider of low-carbon electricity to support the EU's green transition. Its role in the development of smart grids and energy corridors is particularly relevant within the framework of EU Trans-European Networks for Energy (TEN-E), and cooperation with Central European countries could generate synergy for regional energy transition and security.

Ukraine's natural gas infrastructure plays a critical role in supporting the EU's diversification strategy. Integration of Ukrainian and Polish transmission systems within the North-South Gas Corridor allows for the direct flow of natural gas from the Świnoujście LNG Terminal through Central and Eastern Europe. Moreover, Ukraine's participation in the Trans-Balkan Corridor – especially in reverse flow mode – links Greek LNG terminals with Ukraine's underground natural gas storage and regional consumers. Ukraine offers the EU strategic natural gas storage capacity, enabling member states to mitigate price volatility and implement plans for a regional reserve. This creates the basis for a regional energy trading platform encompassing natural gas of various origins, including green gases such as biogas and hydrogen.

In February 2023, Ukraine and the EU signed a Memorandum on Strategic Partnership in biomethane, hydrogen,

and other synthetic gases[11]. By 2025, Ukraine's Gas TSO, alongside key stakeholders from EU countries, launched the "Ukraine-EU Hydrogen Corridor" initiative. Regulatory reforms are ongoing to align biomethane production standards with EU requirements[12]. Ukraine's biomethane production potential is estimated at 1 bcm by 2030 and up to 22 bcm per year by 2050. In February 2025, Ukraine exported its first batch of biomethane – produced entirely from livestock waste – to Germany[13]. In the nuclear sector, Ukraine became the first country to fully replace Russian nuclear fuel in Soviet-design reactors. Its partnership with Westinghouse enables the production of fuel assemblies for VVER-1000 and VVER-440 reactors, opening the possibility of developing an independent nuclear supply chain for Central European countries.

Lessons from Ukraine: A blueprint for regional crisis preparedness

The war has revealed gaps in existing regional mechanisms for energy crisis response and infrastructure resilience. The Ukrainian case illustrates the need for a comprehensive regional framework to coordinate infrastructure protection, equipment supply, and post-crisis recovery[14].

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11 European Commission, *Memorandum of understanding between the European Union and Ukraine on a Strategic Partnership on Biomethane, Hydrogen and other Synthetic Gases*, 2 February 2023, https://energy.ec.europa.eu/publications/memorandum-understanding-between-european-union-and-ukraine-strategic-partnership-biomethane_en [14.07.2025].

12 UA Transmission System Operator, *Memorandum signed on Ukraine–EU Hydrogen Corridor*, 16 January 2025, https://tsoua.com/en/news/memorandum-signed-on-ukraine-eu-hydrogen-corridor/ [16.07.2025].

13 Ministry of Energy, *Україна розпочала експорт біометану до Європейського Союзу*, 7 July 2025, https://mev.gov.ua/novyna/ukrayina-rozpochala-eksport-biometanu-do-yevropeyskoho-soyuzu [14.07.2025].

14 T. Jermalavičius, H. Rõigas, O. Sukhodolia, D. Teperik, *The Staying Power of Ukrainian Lights. Lessons of Wartime Resilience of the Electricity Sector*, International Centre for Defence and Security, Tallin 2025, p. 61.

In war conditions, traditional peacetime tools are insufficient. Market mechanisms often fail: when EU electricity prices exceeded those in Ukraine, domestic consumers lacked the incentive to import. Conversely, in cases where the demand for electricity in the EU markets exceeded the supply, the volume of possible energy flow to Ukraine was limited. A wartime-specific regulatory framework is needed to enable stable and equitable energy flows during crises, supported by state intervention and specialised mechanisms beyond TSO emergency support or civil protection tools. In addition, political processes in individual countries also significantly affect the transborder trading[15]. Restrictions on the flow of electricity to Ukraine in certain periods were applied by different countries for different reasons (due to the instability of renewable generation production, fuel shortages at thermal power plants, accidents, or scheduled repairs).

A viable path forward is the institutionalisation of joint regional risk analysis platforms and scenario-based planning groups among neighbouring countries. Regulation (EU) 2019/941 on risk preparedness in the electricity sector provides a legal basis to agree on bilateral and regional measures for crisis prevention and management. These tools should be extended to include third countries like Ukraine with strategic interconnection to the EU system. The establishment of a joint regional reserve of energy equipment and materials, shared among partner countries, would enhance collective resilience and serve as a risk insurance mechanism for rapid response.

Conclusions

Ukraine emerges as an important actor on the Central European energy landscape. Its accelerated alignment with EU

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[15] K. Sribnyanska, *Угорщина пригрозила Україні "вимкненням світла"*, 22 July 2024, https://apostrophe.ua/ua/news/economy/2024-07-22/vengriya-prigrozila-ukraine-vyiklyucheniem-sveta/327058 [20.07.2025].

energy legislation, integration into regional electricity and natural gas systems, and active participation in cross-border energy trade confirm its strategic value. The war has only further emphasised the urgency of establishing robust regional energy cooperation and crisis response frameworks. A coordinated system of resilient infrastructure, diversified supply chains, and shared crisis preparedness mechanisms will not only strengthen the energy security of Ukraine but also the entire region's energy stability.

THE EU AND US ENERGY RESPONSE TO THE WAR IN UKRAINE

Adrian Kondaszewski

Following Russia's full-scale invasion of Ukraine in February 2022, the European Union and the United States implemented a set of economic and political sanctions aimed at Russian decision-makers and businesses, with the goal of limiting the Russian Federation's ability to finance its war efforts. One of the primary targets of these measures was Russia's energy sector, a traditional source of significant revenue for the Russian state budget. Another key objective of sanctioning this sector was to eliminate the political leverage Russia wielded through energy exports to Europe. Russia had repeatedly used energy carriers as tools of economic blackmail; the aggression against Ukraine presented a timely opportunity to pursue decisive actions toward reducing dependence on eastern supplies, accelerating the EU's energy transition, and phasing out fossil fuels. However, despite early political commitments made in the days following the invasion, the path to full independence from Russian energy and the termination of contracts proved to be long and challenging.

Throughout this process, the European Union and its Member States were supported by the United States, which aligned its sanctions policy with that of the EU, targeting Russia's ability to export energy commodities. At the same time, Washington politically backed its domestic extraction industries in efforts to expand production and export capacity for American crude oil and natural gas.

This article seeks to provide a synthetic summary of the EU and US measures to restrict Russian exports – particularly crude oil and natural gas – to European markets, and to evaluate their effectiveness in light of Europe's stated goals, namely: (1) enhancing the energy security of both the EU and Ukraine, while simultaneously curbing Russia's export capacity and the related revenue that finances Moscow's war machine; and (2) accelerating the green energy transition within the EU.

European Union

The objective of reducing dependence on Russian energy resources – particularly natural gas – had long been a key component of energy policy in many Central and Eastern European countries (notably Poland and the Baltic countries). After years of consistent lobbying by these countries, motivated by geopolitical developments such as Russia's natural gas blackmail of Ukraine in 2009–2010, the construction of Nord Stream 1, and the invasion of Crimea and Eastern Ukraine in 2014, this objective became enshrined in EU-level legislation related to energy security and the development of a single energy market (cf. the Gas Security of Supply Regulation[1], the Intergovernmental Agreements Decision[2], and the Energy Union Communication[3]). Over time, it became a central pillar of the EU's energy policy.

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1 European Union, *Regulation (EU) 2017/1938 of the European Parliament and of the Council of 25 October 2017 concerning measures to safeguard the security of gas supply and repealing Regulation (EU) No 994/2010*, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32017R1938 [25.07.2025].

2 Unia Europejska, *Decyzja Parlamentu Europejskiego i Rady w sprawie ustanowienia mechanizmu wymiany informacji w odniesieniu do umów międzyrządowych w dziedzinie energii między państwami członkowskimi a państwami trzecimi i uchylająca decyzję nr 994/2012/UE*, https://eur-lex.europa.eu/legal-content/PL/TXT/PDF/?uri=CELEX:52016PC0053.

3 European Union, *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee,*

EU efforts to improve energy security and supply reliability were increasingly aimed at reducing the role of Gazprom – the primary supplier of Russian natural gas – in the European energy market. This objective gained particular traction following the European Commission Directorate-General for Competition's 2015 statement of objections against Gazprom for abusing its dominant market position in the EU[4]. Notably contentious was Gazprom's decision, in collaboration with European companies from the Netherlands, the UK, France, Austria, and Germany, to construct a second Nord Stream pipeline under the Baltic Sea. The investment faced united opposition from the heads of the European Commission, European Council, European Parliament, and successive US presidents – alongside leaders of several EU Member States. This controversial infrastructure project prompted a 2018 revision of the EU Gas Directive, introducing a two-step certification process for natural gas pipelines[5]. In parallel, the United States imposed sanctions on companies involved in Nord Stream 2 through the PEESA (*Protecting Europe's Energy Security Act,* 2019) and CAATSA (*Countering America's Adversaries Through Sanctions Act*, 2017). These sanctions targeted firms supplying equipment, ships, or insurance services, increasing uncertainty around the project and causing significant delays and

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the Committee of the Regions and the European Investment Bank – A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy, https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52015DC0080 [28.06.2025].

4 Gazprom was accused of, among others, a discriminatory pricing policy, limiting access to the transmission infrastructure for other entities, and using prohibited provisions in contracts (e.g., clauses limiting re-export). European Commission, *Antitrust: Commission sends Statement of Objections to Gazprom for alleged abuse of dominance on Central and Eastern European gas supply markets*, 22 April 2015, https://ec.europa.eu/commission/presscorner/detail/en/ip_15_4828 [26.06.2025].

5 European Union, *Directive (EU) 2019/692 of the European Parliament and of the Council of 17 April 2019 amending Directive 2009/73/EC concerning common rules for the internal market in natural gas*, https://eur-lex.europa.eu/eli/dir/2019/692/oj/eng [29.06.2025].

cost overruns. By the time of Russia's full-scale invasion of Ukraine in February 2022, seven years after the construction agreement was signed, the project was still awaiting final approval and activation.

Prior to February 2022, individual Member States, supported by EU institutions, were already working to limit Russia's role in the EU energy market. However, the full-scale invasion marked a fundamental reassessment – on both sides of the Atlantic – of energy relations with Russia, at least initially at the declaratory level. This reassessment was particularly significant for countries that had previously benefited most from close energy ties with Russia, especially in Western Europe. A notable example of this policy shift was German Chancellor Olaf Scholz's declaration of a *Zeitenwende*, signalling a break from Germany's economic model built on cheap Russian natural gas[6].

As a direct consequence of the invasion, EU leaders adopted a political declaration in Versailles in March 2022, committing to phase out Russian fossil fuels[7]. This was simultaneously a gesture of solidarity with Ukraine and a move to protect Member States' own interests by reducing exposure to a politically motivated supplier. A key argument was the desire to limit Russia's budgetary revenues from energy exports, which were helping to finance military operations. In the years leading up to the invasion, the EU was the largest consumer of Russian energy products, which accounted for approximately 45% of EU imports in 2021. The price crisis and fuel cost increases brought the EU's energy bill in 2022 to 160 billion EUR. The Versailles declaration initiated a legal and policy process aimed at

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6 S. Meister, *No More Illusions? The Turning Point in Germany's Russia Policy, German Council on Foreign Relations*, 1 November 2024, https://dgap.org/en/research/publications/no-more-illusions-turning-point-germanys-russia-policy [29.06.2025].

7 European Council, *Informal meeting of heads of state or government*, 10–11 March 2022, https://www.consilium.europa.eu/media/54773/20220311-versailles-declaration-en.pdf [25.06.2025].

delivering on the pledge to cut ties with Russian energy. Moscow responded with anxiety, attempting to intimidate the most energy-dependent Member States by unilaterally terminating natural gas contracts (e.g., with Poland, Lithuania, and Denmark), using the pretext of non-compliance with payment changes to Rubles. This coercion, however, failed; Member States continued seeking alternatives, and none formally withdrew from the Versailles roadmap. Follow-up actions by both Member States and the European Commission reaffirmed the commitment. The declaration became the political foundation for the REPowerEU plan, which outlined measures to phase out Russian energy imports. These included reducing imports from Russia and facilitating alternative sources – through new routes (e.g., LNG expansion) and domestic or EU-wide substitutes (e.g., developing biogas and biomethane). Ultimately, the European Commission proposed legislation to ban the import of Russian natural gas by the end of 2027 for long-term contracts, and by mid-2026 for spot contracts[8].

Due to extensive market interdependencies and infrastructure links, phasing out Russian natural gas proved particularly complex. Other sectors, however, were more straightforward. Just weeks after the invasion, Member States agreed to ban Russian coal imports. In June 2022, the EU adopted its sixth sanctions package, which included an embargo on Russian seaborne crude oil deliveries to the EU. Pipeline deliveries were temporarily exempted due to limited alternatives, though countries like Poland and Germany voluntarily discontinued pipeline imports in favour of other suppliers.

The adoption of crude oil sanctions – though partial – was a major economic and political success for the EU. In 2021, the European Commission estimated the value of

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8 European Commission, *EU to fully end its dependency on Russian energy*, 6 May 2025, https://ec.europa.eu/commission/presscorner/detail/en/ip_25_1131 [14.07.2025].

Russian crude oil and petroleum product exports to the EU at 71 billion EUR. The embargo sent a clear signal of European unity against Russia, despite inflation, the refugee crisis, and public fatigue with the war.

United States of America

The United States, alongside the G7 countries, also decided to impose sanctions on Russian crude oil. Since 2015, the wealthiest states and the European Union had gradually coordinated limited sanctions against Russia, targeting, among other things, access to advanced extraction technologies (e.g., deep-sea drilling), joint energy ventures[9], and trade with companies operating in the Russian-occupied Crimea. The political decision to strike at Russia's refining industry did not provoke major controversy in the US or among other Western states. However, amid an energy price crisis and rising living costs across many Western societies, concerns arose about the potential economic consequences of such measures. Therefore, under pressure from the Biden administration, the G7 and the EU opted to implement a so-called price cap on Russian crude oil, setting it at 60 USD per barrel. Any buyer who paid above this threshold risked being added to Western sanctions lists. On the one hand, the (limited) sanctions and the price cap were designed to reduce the inflow of funds into the Russian state budget. On the other hand, the Biden administration was reluctant to allow a reduction in the global crude oil supply – given that Russia's share in 2022 was estimated at approximately 13%[10] – which could have triggered another surge in

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9 V. Soldatkin, *Foreign shareholders freeze participation in Russia's Arctic LNG 2 – Kommersant*, 25 December 2023, https://www.reuters.com/business/energy/foreign-shareholders-suspend-participation-russias-arctic-lng-2-project-2023-12-25/ [25.06.2025].

10 US Energy Information Administration, *What is OPEC+ and how is it different from OPEC?*, 18 December 2023, https://www.eia.gov/todayinenergy/detail.php?id=61102&utm_source=chatgpt.com [16.07.2025].

prices. Simultaneously, efforts were undertaken to combat suspicious tankers bypassing the sanctions regime, the so-called shadow fleet, which undermined the effectiveness of the restrictions.

While replacing Russian crude oil in Europe did not pose a major challenge for most countries, thanks to the availability of numerous alternatives (e.g., Poland's ORLEN swiftly concluded major contracts with the world's largest producer, Saudi Aramco), securing access to refined petroleum products (particularly diesel) proved somewhat more difficult. The EU's fuel reserves were further strained by the necessity to supply Ukraine, which, having lost its own refineries, became almost entirely dependent on external sources. Nevertheless, after initial disruptions, most countries managed to adapt, and the transformation of the European refining industry took place without dramatic scenes at petrol stations.

Since the sixth package of sanctions, neither the European Union nor the United States has adopted any equally ambitious tool targeting Russia's energy sector. The measures announced in June 2025 to curtail Russian natural gas exports are still subject to months of negotiation. Due to the reluctance of several states to terminate existing contracts with Gazprom, there is no certainty that these talks will lead to a complete import ban by the end of 2027.

Ukraine

The actions of the EU and the US have had a tangible impact on Ukraine's economic and political situation. Kyiv had, in fact, begun significantly limiting, and eventually fully cutting off, Russian natural gas imports well before 2022. Instead, it emphasised domestic extraction and consumption reduction – a strategy made more feasible by the destruction and occupation of parts of the industrial Donbas region. Nevertheless, Ukraine continued to allow the transit of Russian natural gas to the EU through its territory.

This transit was financially beneficial for Ukraine, generating budgetary revenues necessary to maintain the infrastructure. Although Russian propaganda often exaggerated the scale of these earnings, the Ukrainian authorities compared them with the cost of Russian attacks on energy infrastructure – costs that were exponentially higher. Transit also acted as a form of deterrence: the presence of active transmission infrastructure discouraged Russia from targeting these facilities with missile strikes. Moreover, Moscow had an interest in maintaining transit through Ukraine to ensure uninterrupted supplies to its most loyal clients in Central and Eastern Europe.

However, as more countries ceased purchasing natural gas from Gazprom and EU leaders committed to fully severing energy ties with Moscow, the rationale for maintaining Ukrainian transit became increasingly tenuous. According to experts as well as Ukraine's transmission system operator, a minimum volume of about 30 bcm per year is necessary to keep the infrastructure operational. Shrinking demand from Central and Eastern Europe could no longer sustain such a volume. Consequently, as of 1 January 2025, the transmission agreement was not extended, and natural gas flows through Ukraine's transit corridors ceased entirely. A decisive role in this development was played by the European Commission, the Energy Community Secretariat, and several Member States, all of which firmly opposed the idea of renewing the transit contract under existing terms. Gazprom theoretically retained the option to reserve capacity at the Russia-Ukraine border and transmit natural gas to the EU without a long-term agreement. However, such a solution would require compliance with EU market rules and would not guarantee the minimum volumes needed for stable system operation.

Despite initial concerns over the potential instability in Central and Eastern European natural gas markets, the consequences of halting transit via Ukraine were not catastrophic. In areas where Russian natural gas remained in

demand, it continued to arrive via alternative routes such as Turkey or the Black Sea. Even though Ukraine lost its transit revenues, its natural gas system remains functional, partially supported by reverse flows from the EU. For instance, in spring 2025, Poland's ORLEN signed two contracts with Naftogaz to supply this commodity to Ukraine via the LNG terminals in Świnoujście (Poland) and Klaipėda (Lithuania)[11]. Ukraine's rejection of the Gazprom transit contract and its shift toward EU regulations and network codes for transmission capacity reservations may also serve as a valuable asset in Kyiv's future accession negotiations with the European Commission.

Conclusions

The EU's measures targeting Russian energy deliveries did not trigger an energy crisis or major disruptions in the functioning of the Union's energy market. On the contrary, reducing Russian supplies led to more efficient resource use (for example, between 2021 and 2025, the EU reduced natural gas consumption by 17%) and focused attention on developing alternatives such as building essential interconnectors and new LNG terminals. In these efforts, the EU found a close partner in the United States, which in recent years, regardless of the administration in the White House, has also perceived curbing Russian influence as a strategic interest.

Finally, the need to eliminate Russian energy resources from the European market has highlighted the urgency of accelerating the green transition, which in the long term supports the objective of energy security. According to the European Commission, the green transition should be one of the key mitigation measures. This has led to increased

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[11] ORLEN, *ORLEN to supply US LNG to Ukraine*, 18 March 2025, https://www.orlen.pl/en/about-the-company/media/press-releases/current/2025/March-2025/orlen-to-supply-us-lng-to-ukraine [19.07.2025].

interest in alternative fuels such as biomethane and green hydrogen. EU statistics[12] confirm this policy shift, demonstrating an unprecedented transition toward zero-emission fuels.

There is hope that Ukraine will follow a similar path and that, after the conclusion of the devastating war, the country's reconstruction will take place in a manner consistent with market principles, environmental standards, and efficient resource utilisation – while remaining fully isolated from Russian influence in energy supply. In recent years, the Ukrainian government has laid critical foundations in this regard, including the implementation of over 60% of EU energy regulations, the discontinuation of Russian natural gas transit contracts, and the adoption of plans to decentralise and base the future energy system on zero-emission fuels[13].

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12 In 2021–2024, the generation capacity of wind and solar farms in the EU increased by 58%. European Commission, *REPowerEU – 3 years on*, https://energy.ec.europa.eu/topics/markets-and-consumers/actions-and-measures-energy-prices/repowereu-3-years_en [15.07.2025].

13 DiXi Group, *Monitoring of Ukraine's National Energy and Climate Plan (NECP) Q1 2025*, 16 April 2025, https://dixigroup.org/en/analytic/monitoring-of-ukraines-national-energy-and-climate-plan-necp-q1-2025/ [29.06.2025].

THE ENERGY COMMITMENT OF EXTERNAL ACTORS IN THE UKRAINE WAR AND THE EUROPEAN UNION'S RESPONSE

Cosmin Gabriel Păcuraru

Introduction

The Russian Federation has begun to actively use energy resources as a foreign policy tool since the rise to power of Vladimir Putin. Thus, even before 20 February 2022, it began to blackmail the European Union. The peak of this energy blackmail was in 2022, the period when Europe tried to find solutions to cover its demand for natural gas and electricity. One of Russia's tactics in the war with Ukraine was the occupation of territories rich in critical and energy material deposits and the attack on energy production and transport infrastructure. Other countries have energy interests in the EU and act to either help or undermine. The European Union is trying to find solutions to ensure a safe, cheap, and if possible, green energy supply.

The energy attack by the Russian Federation, part of the hybrid war

The war launched by Russia against Ukraine in February 2022 has profoundly disrupted the European and global

energy sector. Historically, Ukraine has been an essential corridor for the transit of Russian natural gas to Europe through its network of pipelines (such as the Brotherhood or Soyuz pipeline). The conflict has amplified Europe's dependence on Russian energy, but it has also accelerated efforts to diversify supply sources.

Thus, Russia, one of the largest producers of natural gas and crude oil in the world, has used energy as a tool for geopolitical pressure. Reducing or halting natural gas deliveries to Europe through routes crossing Ukraine, via Nord Stream, or southern routes, was a tactic to destabilise Western economies and test EU solidarity, causing energy prices to rise significantly and unjustifiably. The sanctions imposed on Russia by the EU, the USA, and other countries also targeted the energy sector, limiting its access to technologies and markets. However, Russia has redirected its exports to other countries such as China and India, which have continued to purchase coal, crude oil, and natural gas at reduced prices. It is difficult to quantify the impact of these sanctions, which have been increasing year by year, but the economy of the Russian Federation does not look good after three years of war and sanctions.

The geopolitical context before 2022 reveals several fault lines: Europe's dependence on Russia, which began in the 1980s with the construction of pipelines (those in Ukraine, TurkStream, BlueStream, North Stream I and II), the EU's weak efforts to diversify energy supply, and Russia's obstruction of all resources and energy supply routes to Europe through the use of existing frozen conflicts (Transnistria and Nagorno-Karabakh – 1991) and the instigation of new conflicts, followed by their freezing (South Ossetia, Abkhazia – 2008, Donbas and Crimea 2014). The created situation led Russia to use energy as a tool of geopolitical warfare, with Ukraine becoming a critical point, both as a transit route for natural gas and as a holder of resources (Donbas and the Black Sea). The aggression in 2022 shattered this status quo, forcing a rapid realignment

of energy flows and accelerating the green transition, which led to a departure from the monopoly on Russian fossil fuels and an entry into the monopoly on metals and rare earths, monopolised by the People's Republic of China.

Before 2022, Europe imported approximately 40% of its natural gas, 27% of its crude oil, and 46% of its coal from the Russian Federation, with some countries being highly dependent (Germany, Austria, Slovakia, and Hungary). In 2006 and 2009, there were two natural gas crises triggered by Russia, which interrupted the supply through Ukraine due to price disputes and accusations of natural gas theft, affecting Europe. On 1 January 2025, not a single molecule of Russian natural gas passed through the Ukrainian pipelines, whereas until February 2022, approximately one-third of European imports went through them. In 2025, the only route for Russian natural gas supply is TurkStream, which is not even operating at full capacity. Probably throughout 2025, Europe will import less than 25 bcm, whereas in 2021 it imported approximately 155 bcm and the total import capacities from Russia are approximately 320 bcm.

Pipeline	Primary EU destination	2021	2024
Russian LNG	Mainly Spain, France, Belgium, the Netherlands	13	21
Ukrainian Transit	Austria and Slovakia	40	17
TurkStream	Hungary via Turkey and the Balkans	13	16
Nord Stream	Germany via Baltic Sea	60	0
Yamal	Poland via Belarus	31	0
Total Russian gas		**157**	**54**
Share of Russian gas in total EU imports		*43%*	*18%*

Source: Bruegel.

Fig. 1. Russian gas imports to the EU 2021–2025. Source: www.bruegel.org/analysis/europe-urgently-needs-common-strategy-russian-gas.

What are the alternative solutions for the European Union?

The largest energy consumption is thermal energy for household and industrial use. This consumption is ensured by natural gas. The European Union cannot give up the use of this commodity but can only act towards making its use more efficient. Starting in November 2021, the United States

anticipated an energy crisis in Europe and began securing large quantities of natural gas to supply it. Norway became the largest supplier of pipeline natural gas, but the quantities imported by the EU were not sufficient. Thus, at the beginning of the energy crisis triggered by the war in Ukraine, Qatar became the largest supplier for a few months, with the United States taking its place in the following months. Knowing that all non-Russian natural gas pipeline transport capacities were and are contracted (long-term), the only supply possibility is with LNG. Thus, within a few months, terminals capable of receiving, regasifying, and injecting into the European natural gas transport system were built, increasing Europe's LNG import capacity.

Thus, the European Union intends to completely eliminate imports of Russian natural gas by the end of 2027, according to a plan presented on 6 May 2025. This objective is part of the strategy to reduce energy dependence on Russia. It is established that by the end of 2025, the EU will prohibit (through the creation of a legislative framework) the signing of new contracts for Russian natural gas and eliminate spot purchases. By the end of 2027, all existing contracts, including imports of natural gas and liquefied natural gas (LNG) from Russia, should be gradually eliminated. This will be done by proposing legal measures to allow European companies to terminate existing contracts without financial penalties. These contracts include "take-or-pay" clauses, which obligate buyers to pay for the contracted volumes, even if they do not consume them. The European Commission is examining legal options, such as invoking the "difficulties" caused by post-2022 legislative changes or other legal mechanisms, although invoking "force majeure" is considered difficult.

The only solution is to diversify supply sources, which can include increasing imports of American LNG, which accounted for 16.7% of EU natural gas in 2024, given that Norway, the main supplier to the EU in 2024, had 33.6% of the imported natural gas in 2024, and cannot increase

supply. The EU also wants to increase LNG imports from Qatar and natural gas imports through pipelines transporting natural gas from Algeria (4.2%) and Azerbaijan (14.1%).

It is also quite difficult to eliminate this commodity from the energy mix. It has been demonstrated that the introduction of intermittent renewables creates significant problems for electricity transmission and distribution networks, with the most conclusive example being the blackout on the Iberian Peninsula at the end of April 2025. The transition to clean energy, which began many years ago, first more decisively through the Green Deal, then through Fit for 55, and more recently through REPowerEU, all aimed at replacing fossil fuels with renewables, in addition to the fact that the Chinese have the monopoly on metals and rare earths (generically referred to by the EU as critical materials), has actually increased the price of electricity across the entire European Union.

What the EU is aiming for represents a huge effort, due to residual dependency: in 2024, Russia supplied 18.8% of the EU's natural gas, mainly LNG, which reached record levels after the reduction of pipeline deliveries. We must not forget the opposition from some member states, where self-proclaimed "sovereignist" parties are in power, with Hungary and Slovakia continuing to support Russian imports for economic and political reasons. And also, the continued import of Russian gas under a different label (through Turkey or Azerbaijan), done by Bulgaria, Romania, Hungary, Slovakia, or Austria.

The financialization of energy has proven to do nothing but increase energy prices, to the detriment of consumers. The Draghi report, published in the fall of 2024, clearly posits the idea that the EU should find ways to reduce energy prices, which are three times higher than in the United States and 2.5 times higher than in China, in order for the European economy to become more competitive.

Black Sea natural gas could be a solution for Central and Eastern Europe. Europe's energy diversification with

this limited resource could cover a small part of the overall consumption but might cover a portion of the consumption in Central and Eastern Europe. The EU has encouraged alternative projects like Nabucco, which was supposed to bring natural gas from Azerbaijan, and the Southern Gas Corridor, known as TANAP, which is operational, but this is insufficient. Ukraine, which is hindered by the occupation of Crimea, together with Romania, Bulgaria, and Turkey, has access to these resources.

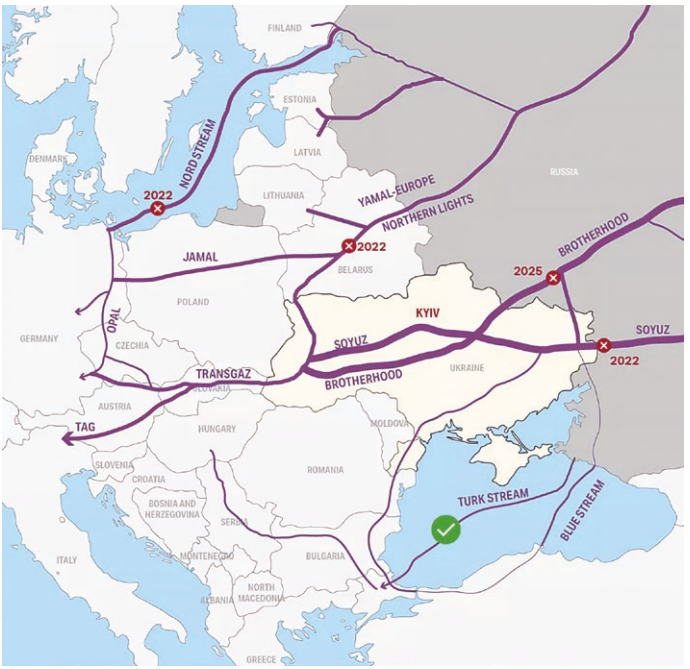

Fig. 2. Structure of Russian gas pipelines to Europe. Source: www.bruegel.org/analysis/europe-urgently-needs-common-strategy-russian-gas.

Ukraine in a difficult energy situation, but with the help of the USA and the EU

24 February 2024 was chosen because tests were supposed to begin for the synchronization of the Ukrainian energy system with the European ENTSO-E, with Russia hoping to create technical problems that could have spread throughout the entire European electricity system through attacks on

the Ukrainian transmission operator. Those who oversee the technical state of ENTSO-E urgently decided to insulate the two energy systems that were about to enter the European transport system: Ukraine's and the Republic of Moldova's. This hybrid attack was followed by many others on the Ukrainian production, transport, and distribution capacities of electric and thermal energy. After more than three years of war, the Ukrainian power system is lacking significant production capacities and important transport sections, with transformer systems and key interconnection nodes being bombed. The heating production and transport systems were also destroyed, especially in the large cities, suffering due to the destruction of thermal power plants, most of which were cogeneration plants.

The EU supported Ukraine's energy needs by synchronizing the Ukrainian electrical grid with the European one, only finalised on 16 March 2022. Additionally, the EU has delivered generators and equipment to support the Ukrainian energy grid affected by attacks. Ukraine holds reserves of strategic materials, the problem being that more than 70% of these are located in the territory forcibly seized by the Russian Federation. After three years of conflict, it is evident that the energy commitment of external actors in the war in Ukraine is nothing more than a struggle for control of resources and geopolitical influence.

At the end of April 2025, US Treasury Secretary Scott Bessent and Ukrainian First Deputy Prime Minister Yulia Syrydenko signed the agreement "on the creation of the American-Ukrainian Reconstruction Fund" in Washington. The United States and Ukraine have been in these negotiations since before Donald Trump took office, and they have gone through some misunderstandings that have been overcome. The authorities in Kyiv say that Ukraine possesses deposits of over 20 critical minerals and energy resources, valued at several trillion dollars. The agreement reached is actually a "political" one that establishes the framework for cooperation regarding the exploration and exploitation of

resources, the sale of minerals, and the American aid that Ukraine will receive. The signing of a technical agreement and one regarding the investment fund is next. It is important to note that from the profits of this fund, Ukraine will begin to repay the aid, estimated at 175 billion USD, granted by the USA.

Considering that metals and rare earths are essential (also) for the energy industry, the United States' energy involvement can be summarised as follows: it provides weapons and ammunition in exchange for access to critical material resources. It does not offer direct security guarantees but given that most resources are located in territories occupied by Russia, we understand that "prepayment for these" cannot be a loss-making investment. Therefore, indirectly, there is a guarantee that at least the occupied territories in Donbas will return under Ukraine's control.

The United States is on an energy offensive in Eastern Europe and the Arctic

There are also policies for the export of technology in nuclear energy. Romania is the most advantaged because it has two reactors already in operation for 30 years and a well-established school for training specialists in the field. Thus, there are advanced projects for the completion of two more CANDU technology nuclear reactors at the Cernavodă Power Plant and a project for the implementation of small modular reactor (SMR) technology in Doicești. Additionally, American companies are involved in the modernisation of Reactor 1 at Cernavodă, which will begin on 1 January 2027. The funding is provided by Eximbank from the United States and private banks from the United States, Canada, South Korea, and Italy. We must also mention the investment in high-capacity redox batteries in Oradea, a collaboration between Sinteza and Lockheed Martin.

Poland, which currently does not have nuclear power plants, aims to develop a nuclear industry to reduce

dependence on coal and meet energy sustainability goals. The United States plays a key role in this process by providing technology and funding. Poland has chosen the American company Westinghouse Electric Company, in partnership with Bechtel, to build its first nuclear power plant in Choczewo, near the Baltic Sea. It will use AP1000 reactors, and the estimated costs amount to approximately 40 billion USD, with completion expected by 2040. The United States also financially supports Polish nuclear projects through agencies such as the United States International Development Finance Corporation (1 billion USD) and the US Export-Import Bank (17 million USD). These investments are seen as a means to reduce the region's energy dependence on Russia, and the nuclear power plants will also supply the AI centres of Google and Alphabet in Poland.

Turkey aims to diversify its energy sources and reduce import dependence, and the United States is involved in negotiations to support this goal, although concrete projects are less advanced compared to Turkey's other partnerships. Turkey wants to strengthen its energy security, and the USA sees this cooperation as an opportunity to counterbalance Russia's presence. Although Turkey is in the midst of constructing a nuclear power plant with Russian technology, being worked on by RosAtom and located on the Mediterranean coast at Akkuyu, it also plans to build one with American technology on the Black Sea coast at Sinop. The memorandum concluded last year also refers to the introduction of NuScale's SMR technology, with the conditions and location yet to be determined.

The improbable inclusion of Greenland into the United States would have major energy and geopolitical implications, especially in the geography of the Arctic region, which is becoming increasingly strategic due to mineral and energy resources and potential maritime routes, thereby favouring a much more significant strategic position. Today, the United States possesses only a small part of the continental

shelf beneath the Arctic, due to Alaska; the largest area is administered by the Russian Federation, followed by Canada, Denmark through Greenland, and Norway.

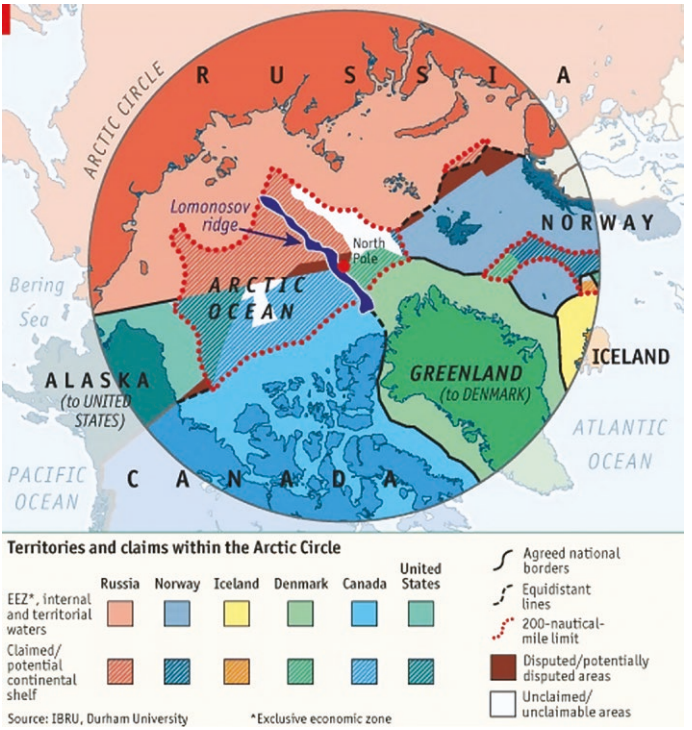

Fig. 3. The current division of the Arctic continental shelf. Source: geopolitics.ro/how-profitable-is-the-exploitation-of-energy-resources-in-the-arctic-region-part-two/.

The energy implications will grant the US access to a large reserve of hydrocarbons (approximately 22% of global resources) beneath the Arctic, to which we add the resources from Greenland's subsoil. To these, we add the resources of rare minerals (e.g., neodymium, dysprosium), essential for green technologies, batteries, wind turbines, and the defence industry. Thus, the USA could counter China's dominance in the market for these materials, strengthening its energy and technological security. The increase in hydrocarbon production from Greenland could influence global crude oil and natural gas prices, giving the

US an advantage in economic negotiations. There are also discussions about possible joint energy projects between the US and Russia in the Arctic, such as investments in hydrocarbons. However, an annexation of Greenland could exacerbate tensions, reducing the chances of cooperation. For the time being, this topic has been abandoned by the American administration.

The Turks hold the taps

Turkey has been, is, and will be an important player in the regional energy equation, and beyond. At this moment, the functional import routes to Southern Europe are TANAP, Turk Stream, and Blue Stream. TANAP (32 bcm/year) brings natural gas from Azerbaijan, while Turk Stream (32 bcm/year) and Blue Stream (16 bcm/year) bring natural gas from the Russian Federation.

In other words, if Turkey's consumption requirement is 50 bcm/year, only 3.5 bcm/year comes from domestic production, to which we add LNG imports of 15 bcm/year, we deduce that the potential for natural gas transport to Europe is over 45 bcm/year. It wouldn't be a problem if part of the natural gas coming from domestic production (from the Black Sea), along with that from Azerbaijan or LNG imports, were re-exported to Europe, while the natural gas from the Russian Federation was used for domestic consumption. In other words, Turkey would be in the most favourable energy situation, profiting from the price differences between the cheap natural gas imported from Russia and the natural gas exported from its own production, Azerbaijan, or LNG imports.

China and India are buying cheap energy

These countries have taken advantage of Western sanctions to buy Russian crude oil and LNG at extremely low prices, indirectly supporting the Russian economy. China,

in particular, has intensified energy cooperation with Russia through projects such as the Power of Siberia pipeline, which has a transport capacity of 38 bcm/year, small compared to China's needs, still in the project stage, and Power of Siberia II, which should have a capacity of 50 bcm/year. China's gas demand is at least 600 bcm/year, much more than the capacity for transporting Russian natural gas to Europe, which is 350 bcm/year. Estimates of Russian LNG imports to China are around 12 bcm in 2024, which is very little. In 2024, China imported the largest amount of crude oil from Russia, nearly 110 million tonnes, and there is a trend of this increasing. Coal imports were also at a record high of nearly 90 million tonnes.

In India, only small quantities of Russian LNG entered because it does not have LNG terminals. The import of LNG in 2025 was 3.4 mcm, with 46 million tonnes of crude oil and 25 million tonnes of coal entering in 2024. It turns out that Russia's fossil fuel exports to China and India have increased, but they do not compensate for those to Europe before 2022, which creates a significant economic problem for Russia. We must also not forget that due to China's monopoly on critical materials, there is a significant vulnerability for all countries considering the development of

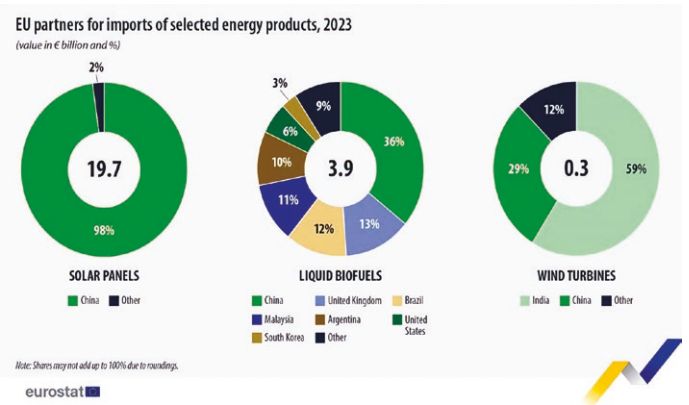

Fig. 4. EU energy imports by fuel type. Source: ec.europa.eu/eurostat/documents/4187653/18051237/international-trade-green-energy-products-2023.xlsx/1ddef614-9d92-52f1-ce81-a253560a3253?t=1728485584139.

photovoltaic production capacities, with the EU importing over 95% of these from China in 2024. In the case of wind turbines, India dominates imports into the EU with 59%, followed by China.

The problem lies in the fact that all the automation and control aspects of these systems are done through Chinese clouds, and in the event of hybrid belligerent actions, the authorities of the People's Republic of China can stop or disrupt these capabilities anytime to desynchronize the energy systems of EU member countries.

Hybridization of conflicts through proxies

If North Korea does not contribute to the energy game in the geopolitics of the Russian Federation, Iran and its state or non-state allies are a further part of the global energy conflict. The lines of this conflict are to block the supply of energy products and any alternative energy projects.

Fig. 5. The new energy route to Europe for crude oil and LNG. Processed by Cosmin Păcuraru.

There are three chokepoints for the energy routes from Qatar, the United Arab Emirates, Kuwait, and Saudi Arabia, namely the Strait of Hormuz, the Bab-el-Mandeb Strait, and the Suez Canal. The Strait of Hormuz is the most threatened

point because the Houthi group from Yemen launches attacks on crude oil and LNG tankers. And the Bab-el-Mandeb Strait is a vulnerability because there is a Chinese naval base nearby in Djibouti, located near the port of Doraleh.

Syria has also played a crucial role in blocking all energy product pipeline routes between the Near East and Europe. The orientation of the new leadership in Syria, which is suspected of being close to Iran, is still uncertain. Non-state actors, Hamas from the Gaza Strip and Hezbollah from Lebanon, have been used as proxies by the Russian Federation, through Iran, to destabilize the region and reduce all neighbouring states' access to the natural gas reserves in the Mediterranean Sea.

Possible EU solutions in an uncertain future

Energy efficiency is and must be among the Union's top priorities. Improving consumption to reduce losses, improving production to increase it, and improving transportation and distribution to reduce technological losses are also necessary. Having the examples of Ukraine, where the national energy system collapsed under the pressure of Russian bombings, and the blackout on the Iberian Peninsula, where the transport networks failed under the shocks of intermittent renewable energy production, extending towards the French energy system, the result is that their architecture needs to be rethought, moving production closer to consumers. Thus, EU decision-makers need to consider flexibility in legislation that allows for the organisation of energy systems towards individual/local/regional energy self-sufficiency, based on local energy resources and individual/local/regional demand.

Also, knowing the geopolitical dangers of the monopoly of a single resource, here referring to the monopoly of Russian natural gas to which Europe has been captive, it is necessary to analyse the creation of as many alternative energy supply options (natural gas and crude oil) as possible,

with as many supplier states as possible, that are not under the influence of the Russian Federation and are not dictatorships (Iran). The possibility of supplying electricity from outside the EU should not be overlooked either. Thus, a direct current cable is planned to supply electricity from Azerbaijan, through Georgia, under the Black Sea, through Romania, Hungary, and Western Europe. Although the European Commission claims it will import green energy, data shows that Azerbaijan produces insufficient green energy, with this making up only 5% of the energy mix.

Another solution for ensuring energy supply is nuclear energy. The United States is on an energy offensive in Europe, especially after Donald Trump issued an executive order promoting nuclear energy produced with advanced technologies as critical infrastructure installations in the defence, and artificial intelligence industries and promoting it in allied states. It is projected that by 2050, the EU will have 17% nuclear energy in its primary mix, 12% in the thermal energy consumption mix, and 18% in the electrical mix.

Renewable energy is not only obtained from photovoltaics and wind but also from biomass, agrobiomass, and municipal waste. There are two solutions for generating electrical and thermal energy: through anaerobic digestion and the transformation of the "wet fraction" from waste into biogas and then into electrical and/or thermal energy, and through the gasification of solid municipal waste and the production of syngas, which in turn is converted into electrical and/or thermal energy or the extraction of hydrogen from it. The same projections indicate that approximately 20% of the EU's primary mix would be obtained through these technologies. With the rethinking of a new architecture for national electro-energy systems, the rethinking of electricity transport and distribution networks must also be considered to overcome the technological problems that have arisen with the introduction of solar and wind capacities.

And last but not least, to protect vulnerable populations from energy prices, we believe that energy markets need

to be rethought. These have been excessively financialised through the introduction of futures contracts or contracts for difference. The futures market, according to the European Commission's calculations, is 17 times larger than the spot market, if we consider the quantity of goods traded, which is nonsensical. Additionally, some states have introduced contracts for difference for investments in renewable energy, and the price of energy for these is unjustifiably high.

Conclusions

The European Union has been assailed by hybrid attacks, with the energy industry being the most affected, manifesting through disruptions in energy supply, price increases, and additional economic pressures. The EU has also become vulnerable to China's monopoly on critical materials. This can have a significant impact on the EU economy, amplifying the risks generated by energy dependence and other hybrid threats, including those related to Russia's energy strategy. At this moment, there is a dependence on supply chains dominated by China. Any repetition of the disruption of these supply chains, like the one from 2020–2021, can have a disastrous impact on the EU's projected energy transition, negatively affecting strategic industries, economic competitiveness, and involving amplified geopolitical and economic risks as well as increased economic costs of supply diversification.

It is possible that the "net zero" objective may not be achieved precisely because of the aforementioned reasons, with France and Germany already considering a return to natural gas, likely as a result of pressures from the United States. The European Commission is continuously adapting its measures to counter hybrid attacks and mitigate vulnerabilities in order to achieve its economic targets, alongside those of decarbonizing the economy.

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