sipri

NAVIGATING GREEN GEOPOLITICS

Perils and Promise of Energy Transition and the Case of Ukraine

JIAYI ZHOU AND BÁRBARA MAGALHÃES TEIXEIRA

STOCKHOLM INTERNATIONAL PEACE RESEARCH INSTITUTE

SIPRI is an independent international institute dedicated to research into conflict, armaments, arms control and disarmament. Established in 1966, SIPRI provides data, analysis and recommendations, based on open sources, to policymakers, researchers, media and the interested public.

The Governing Board is not responsible for the views expressed in the publications of the Institute.

STOCKHOLM INTERNATIONAL PEACE RESEARCH INSTITUTE

Signalistgatan 9
SE-169 70 Solna, Sweden
Telephone: +46 8 655 97 00
Email: sipri@sipri.org
Internet: www.sipri.org

NAVIGATING GREEN GEOPOLITICS

Perils and Promise of Energy Transition and the Case of Ukraine

JIAYI ZHOU AND BÁRBARA MAGALHÃES TEIXEIRA

December 2025

sipri

STOCKHOLM INTERNATIONAL
PEACE RESEARCH INSTITUTE

DOI: https://doi.org/10.55163/LIUW9521

Contents

Abbreviations

CBAM	Carbon Border Adjustment Mechanism (European Union)
DRC	Democratic Republic of the Congo
ESG	Environmental, social and governance (standards)
ETS	Emissions trading system
EU	European Union
GDP	Gross domestic product
LNG	Liquefied natural gas
NECP	National Energy and Climate Plan
OECD	Organisation for Economic Co-operation and Development

Executive summary

Energy transition is transforming geopolitics. As countries race to decarbonize their economies, competition over technologies, markets and critical minerals is reshaping relations of power, dependence and vulnerability. Collective action to mitigate climate change, which was once framed as a public good, is now increasingly governed through security logics, industrial policy and zero-sum rivalry. Energy transition is shaped particularly by the interests of great powers: China, the European Union (EU), the Russian Federation and the United States.

China, the EU and the USA represent the largest markets for both fossil fuels and for clean energy technologies. Long-term strategies for industrial competitiveness, supply chain security and energy sovereignty are an essential element of tensions between them. However, while China and the EU have made more durable commitments to energy transition, the USA has recently turned towards a more fossil-fuel based energy policy. Russia, meanwhile, seeks to preserve the hydrocarbon rents that sustain both its economy and its military activities. These competing priorities have contributed to an increasingly fragmented and securitized global landscape for energy transition.

In this context, middle powers and developing countries face both perils and opportunities. On the one hand, the rise of new carbon-free energy technologies, markets and supply chains opens potential pathways for economic diversification, technological upgrading and enhanced geopolitical autonomy. States with abundant renewable resources or critical minerals may be able to leverage them for value creation and strategic influence. On the other hand, energy transition also risks reproducing long-standing patterns of extractivism, unequal exchange and external dependency. Without strong governance frameworks and deliberate policies for domestic value retention, countries risk being locked into low-value segments of global supply chains, while the benefits of green industrialization accrue to advanced economies. In this sense, distributional outcomes of energy transition will depend on how states navigate geopolitical pressures, manage structural constraints, and govern the trade-offs between sovereignty, sustainability and development.

These dynamics are unfolding with particular intensity in Ukraine, which faces acute pressures from the most destructive manifestation of geopolitics: full-scale war. For Ukraine, energy transition is not a purely climate-driven or economic agenda. Russia has weaponized energy dependence for decades, and since 2022 has escalated these tactics by systematically targeting Ukraine's energy system in an attempt to undermine economic stability and civilian resilience. Under these conditions, Ukraine's drive to modernize its energy sector reflects an urgent need to reduce vulnerability, secure critical infrastructure and reinforce sovereignty through enhanced self-sufficiency.

At the same time, Ukraine's transition is shaped by ambitions for deeper integration with the EU. Synchronization with the Continental European electricity grid, alignment with the EU's energy acquis and the adoption of national legislation such as the 2024 Climate Law reflect a strategic reorientation towards the EU. Energy transition has become a key pillar of Ukraine's EU accession process, reinforcing its geopolitical identity as a future EU member state. Ambitious targets illustrate both the promise of accelerated modernization and the challenge of delivering energy transformation under conditions of war, financial strain and constrained institutional capacity.

Ukraine's case sheds light on the opportunities and constraints created by green geopolitics. The country possesses significant renewable energy potential and substantial deposits of minerals considered critical by both the EU and the USA. These endowments position Ukraine as a possible contributor to diversified Western supply chains, including for clean energy technologies. However, this mineral wealth

also exposes Ukraine to new geopolitical pressures. Recent mineral agreements with the USA highlight how wartime support and resource-related interests can become intertwined. In an era of heightened geopolitical competition, such arrangements offer financing and political backing but can also narrow policy space and reinforce asymmetric relations. The risks of green extractivism are similarly salient. Without robust governance, local content requirements and clear industrial policy strategies, Ukraine could bear disproportionate environmental and social costs while others capture high-value gains in processing, manufacturing and technology development. Civil society actors in Ukraine have already emphasized the need for transparent decision-making, environmental due diligence, and public participation in mining and reconstruction projects.

Despite these challenges, Ukraine's experience offers broader lessons for countries navigating energy transition in an unstable geopolitical environment. First, energy transition can strengthen sovereignty and resilience when aligned with long-term security objectives and integrated into broader strategies for geopolitical alignment. Second, diversification (of technologies, partners and markets) is essential for managing dependencies in a fragmented global landscape. Third, governance is central: transparency, participation and environmental standards are not obstacles but preconditions for ensuring that transition delivers inclusive and sustainable benefits.

In sum, while Ukraine's situation is unique, it illuminates global tensions within green geopolitics: between opportunity and constraint, sovereignty and dependence, immediate security needs and long-term sustainability. For many states, the challenge ahead is not only to harness the promise of energy transition but to manage its perils in ways that reinforce resilience, stability and strategic autonomy.

1. Introduction

A decade after the signing of the Paris Agreement, the global context for climate action and clean energy transition has changed dramatically.[1] If 2015 represented a political peak in terms of multilateral cooperation, the years since have instead seen rising interstate tensions, economic unilateralism, and competition over green technology and associated supply chains. For many industrialized states, global climate goals now compete with geopolitics in zero-sum security frameworks that privilege the state, often at the expense of collective action at the international scale.

Energy transition, previously framed as a global public good, is also becoming securitized. For certain states that are dependent on imported energy, transition is considered core to national economic security and domestic industrial policy. Security-related considerations are therefore accelerating their energy transition efforts, but in ways that also escalate trade and political tensions. Meanwhile, several states that export fossil fuels now openly consider energy transition as a threat to national economic security and prosperity. These cleavages are particularly notable among the four so-called great powers—China, the European Union (EU), the Russian Federation and the United States—which have outsized influence in global economic and security matters. China and the EU, both import dependent, have made more durable commitments to transitioning their energy systems, while the governments of Russia and (at least since early 2025) the USA both plan to expand hydrocarbon production and exports.

Strategic competition and latent conflict between these great powers are also spilling over into the markets and territories of other countries, many of which have narrower choices in relation to financing, technological know-how and strategic alignment. This places important constraints on these countries' ability to pursuit energy transition on their own terms. Of course, these countries—from middle powers to developing countries—have diverse interests of their own, which vary according to their resource endowments, political economies, and domestic or foreign policy agendas. However, there is a common interest in avoiding being caught in the crosshairs of energy resource and supply chain competition, while capitalizing on potential opportunities generated by it. These shifts have given rise to what can be referred to as 'green geopolitics': the reshaping of international power relations, dependencies and vulnerabilities through the politics of climate action, green energy technologies and transition-related resources.

This report examines the geopolitical landscape of energy transition, with a particular emphasis on the perils and promise that transition offers middle powers and developing countries. Energy transition has the potential to generate many opportunities for sustainable development, energy access and more balanced interstate relations. However, there are also trade-offs between competitiveness, security and sustainability to consider and great power politics to navigate. The transition's most significant gains remain promises, in the sense that they remain conditional on how states navigate an international environment marked by fragmentation, asymmetries and geopolitical rivalry. In this sense, the promise is the starting point of energy transition, and the perils are the conditions that determine whether that promise can be kept. This report uses the case of Ukraine to explore these tensions in practice, and to draw lessons for other middle powers and developing economies that are making efforts to decarbonize.

[1] Paris Agreement under the United Nations Framework Convention on Climate Change, adopted 12 Dec. 2015, opened for signature 22 Apr. 2016, entered into force 4 Nov. 2016.

Ukraine is, of course, a unique case in many respects. It is at the frontlines of the most destructive form of geopolitics—locked in a war with Russia, whose hydrocarbon exports continue to fund its military aggression. As the report discusses, the war has now given Ukraine's own energy transition a much sharper strategic impetus. At stake is not only Ukraine's economic modernization and environmental well-being, but also its survival, recovery, and longer-term political sovereignty and future. However, Ukraine's energy transition faces competing pressures, domestic as well as internal, that it must carefully navigate. These include governance constraints, institutional capacity challenges and the risk that urgent wartime needs may sideline environmental or social safeguards. Such factors directly shape whether the transition delivers on its promise or remains unfulfilled.

In this respect, an analysis of the perils and opportunities of energy transition in Ukraine can also offer broader insights for other countries that are simultaneously pursuing sustainable development and greater geopolitical resilience. It offers lessons in particular for resource-rich middle powers and developing countries, countries caught between or among competing geopolitical blocs, and conflict-affected states. More broadly, the Ukrainian case illustrates a central argument of this report: that transition remains a geopolitically contested process marred by challenges. Furthermore, it is argued here that the promise of transition can only be realized if states are able to govern the transition in ways that enhance resilience, reduce dependency and foster inclusive, sustainable development.

The report continues in chapter 2 by examining the overall geopolitical context for energy transition, laying out the interests of great powers, and the perils and opportunities this brings for other states. It then focuses on the case of Ukraine, outlining in chapter 3 the domestic imperatives for energy transition while highlighting in chapter 4 the external factors that help and hinder it. Chapter 5 examines more particular trade-offs for Ukraine in pursuing both decarbonization and geopolitical resilience. The report concludes in chapter 6 with a set of more general recommendations for states facing similar pressures.

Energy transition—or the green transition—encompasses an array of highly complicated technical questions and market dynamics; however, this report focuses primarily on the political effort to decarbonize economies. Politics matters because, compared to previous energy transitions, the ongoing transition is notable for the strong role that state interventions have played in the development and deployment of clean energy technologies.[2] As it relates to energy transition fuels, the analysis here focuses on renewable sources of energy while also touching on nuclear power and natural gas. Although the latter both have contested positions within green taxonomy, they remain important elements in both geopolitics and the energy transition landscape.

Finally, traditional geopolitics focuses on optimizing security in state-centric and often zero-sum terms. This report places additional emphasis on the concept of geopolitical resilience. Resilience, according to the Intergovernmental Panel on Climate Change (IPCC), refers to 'the capacity of social, economic and ecosystems to cope with a hazardous event or trend or disturbance, responding or reorganising in ways that maintain their essential function, identity and structure'.[3] As laid out here, this essential idea is key for bridging state-centric forms of security with wider collective environmental, social and economic goals for human well-being.

[2] Pearson, P. J. G. and Foxon, T. J., 'A low carbon industrial revolution? Insights and challenges from past technological and economic transformations', *Energy Policy*, vol. 50 (Nov. 2012).

[3] Intergovernmental Panel on Climate Change (IPCC), Working Group II, *Climate Change 2022: Impacts, Adaptation and Vulnerability*, Contribution to the 6th Assessment Report of the IPCC (Cambridge University Press: Cambridge, 2022), p. 7.

2. The geopolitical context of energy transition

In relation to energy transition, states vary not only in their capacities but also in their levels of ambition. While some states may perceive energy transition to be security-enhancing, others see it as a threat to their domestic or foreign policy interests.[4] However, it is not only divergent approaches to energy transition itself that are generating tensions; a wider trend towards weaponizing economic interdependence—whether through sanctions or trade restrictions—has made both fossil fuel-based energy relationships and clean energy supply chains more politicized. Great powers in particular are increasingly making energy decisions informed by national security and geopolitical considerations, rather than environmental or even purely economic ones.

Strategic competition between great powers reshapes the global political and economic landscape for energy transition. These dynamics reflect 'green geopolitics': the ways in which climate action, clean energy technologies and transition-related resources and critical minerals are reconfiguring patterns of power dependence and vulnerability in the global system. Green geopolitics encompasses both the promise of diversification and energy sovereignty and the perils of new dependencies, coercive leverage and unequal value chains. These dynamics set the wider context for energy transition and also shape the priorities of great powers, middle powers and developing countries—albeit in diverse ways.

State interests are of course not permanent or fixed—nor are they uncontested domestically. Nevertheless, understanding the wider context of green geopolitics requires understanding the benefits and threats that energy transition may pose or be perceived to pose to various political authorities.[5] This chapter first examines the interests of the so-called great powers—China, the European Union, Russia and the United States—as they relate to energy transition. It then discusses how strategic competition between them in turn shapes and constrains choices for middle powers and developing economies.

Great power competition

The great powers have been at the forefront of much of the geopolitical and geoeconomic turbulence of the past decade. China, the EU, Russia and the USA each has outsized influence in the global economy and in international security matters. They represent the largest fossil fuel markets and are responsible for a large proportion of historic and present carbon emissions.[6] However, China, the EU and the USA also represent the main markets for clean energy, where nearly two-thirds of related investments are taking place globally.[7] Russia is also implicated, both as a major hydrocarbon exporter and as a security actor that has escalated the great power tensions that are fragmenting the global economic landscape of energy production, trade, investment and technology.[8]

Particular concerns relate to the threat of supply disruptions and the potential for energy dependence to be weaponized by adversaries. Notably, this was not the case only two decades ago, when economic interdependence—particularly among members of the

[4] Crowley-Vigneau, A., Kalyuzhnova, Y. and Ketenci, N., 'What motivates the "green" transition: Russian and European perspectives', *Resources Policy*, vol. 81 (Mar. 2023).

[5] Bazilian, M. et al., 'Four scenarios of the energy transition: Drivers, consequences, and implications for geopolitics', *WIREs Climate Change*, vol. 11, no. 2 (Mar./Apr. 2020).

[6] Hickel, J., 'Quantifying national responsibility for climate breakdown: An equity-based attribution approach for carbon dioxide emissions in excess of the planetary boundary', *The Lancet Planetary Health*, vol. 9, no. 4 (Sep. 2020).

[7] International Energy Agency (IEA), *World Energy Investments 2025* (IEA: Paris, June 2025).

[8] Aiyar, S., Presbitero, A. F. and Ruta, M. (eds), *Geoeconomic Fragmentation: The Economic Risks from a Fractured World Economy* (Centre for Economic Policy Research: Paris, 2023).

Organisation for Economic Co-operation and Development (OECD)—was considered to be a means of promoting peaceful relations between states and as a source of, rather than a threat to, energy security. Already in the 2000s, politically motivated energy disruptions between Russia and its gas-transit partner Ukraine began to challenge this orthodoxy.[9] The imposition of sanctions by energy-importing states against exporters such as Iran and Russia also grew dramatically.[10] This wider policy reversal—from economic and energy interdependence being a source of prosperity to a source of risk—was further stimulated by heightened geostrategic rivalry and competition between China and the USA and was cemented by Russia's full-scale invasion of Ukraine in February 2022.

New efforts to protect or secure strategic markets—including for energy—fall along geopolitical fault lines: with Russia and China on one side and, on the other, those aligned against them in what can be called the wider West. However, the USA has begun to emphasize a foreign economic policy that is unilateral and ad hoc, rather than being based on global rules.[11] This is splitting even traditional geopolitical alignments and further marks out the international economy as an arena of zero-sum, interest-based transactions. These geopolitical developments have also complicated cooperation around energy transition. Moreover, there are conflicting perspectives on the same side of those geopolitical fault lines as well as across them.

For example, both China and the EU consider energy transition to be a strategic opportunity to reduce their foreign dependencies. China has long been a net importer of all types of fossil fuel and remains the world's largest importer of crude oil.[12] Energy transition addresses China's resource vulnerabilities and has therefore been a strategic priority of the state since the early 2010s.[13] In 2024 its clean energy sector comprised over 10 per cent of its gross domestic product (GDP), and China's investments in clean energy in 2024 came close to equalling the global total investments in fossil fuels.[14] China is projected to account for 60 per cent of the world's expansion of renewable capacity by 2030, and half of all installed renewable capacity in total. It also dominates the manufacturing and export of renewables technologies, batteries and electric vehicles used by other countries.[15] These clean energy technologies require minerals inputs, for which China is reliant on imports.[16] Importantly, however, China also controls by a wide margin the processing of nearly all these energy transition-related minerals (e.g. lithium, nickel, cobalt, copper, graphite and rare earth elements). These minerals are among those that are considered 'critical' by the USA and the EU, in part because China's control of these supply chains constitutes a potential geoeconomic chokepoint for other consumers.[17] Indeed, restrictions imposed by China in 2024–25 on the export

[9] Rodríguez-Fernández, L., Fernández Carvajal, A. B. and Ruiz-Gómez, L. M., 'Evolution of European Union's energy security in gas supply during Russia–Ukraine gas crises (2006–2009)', *Energy Strategy Reviews*, vol. 30 (July 2020).

[10] US Department of the Treasury, 'The Treasury 2021 sanctions review', Oct. 2021, p. 2.

[11] E.g. The White House, 'President Donald J. Trump declares national emergency to increase our competitive edge, protect our sovereignty, and strengthen our national and economic security', Fact sheet, 2 Apr. 2025.

[12] Feng, R., 'China is filling up its oil reserves fast', *Wall Street Journal*, 1 Nov. 2025.

[13] Guilot, L., 'An analysis of China's energy policy from 1981 to 2020: Transitioning towards to a diversified and low-carbon energy system', *Energy Policy*, vol. 162 (Mar. 2022).

[14] Myllyvirta, L., Qin, Q. and Qiu, C., 'Analysis: Clean energy contributed a record 10% of China's GDP in 2024', Centre for Research on Energy and Clean Air (CREA), 19 Feb. 2025.

[15] International Energy Agency (IEA), *Renewables 2024: Analysis and Forecast to 2030* (IEA: Paris, Oct. 2024).

[16] Escobar, B. et al., *Power Playbook: Beijing's Bid to Secure Overseas Transition Minerals* (AidData at William & Mary: Williamsburg, VA, Jan. 2025).

[17] Zhou, J. and Månberger, A., *Critical Minerals and Great Power Competition: An Overview* (SIPRI: Stockholm, Oct. 2024).

of these critical minerals illustrate how supply dependencies can be weaponized in the context of trade tensions and geopolitical rivalry.[18]

The European Union represents the second-largest market for renewables, behind China. It has also been highly dependent on energy imports: nearly 60 per cent of its energy was imported in 2023, the bulk of which was crude oil and natural gas.[19] However, as the world's second largest market and its largest single market, the EU's energy transition agenda positions the EU as a major driver of the transition at home and globally. Its policies include the European Green Deal announced in 2019, legally binding climate targets, and a range of regulatory policies on emissions and environmental standards.[20] The Russia–Ukraine War has accelerated the EU's drive to diversify away from Russian energy supplies, which constituted 45 per cent of its natural gas imports in 2021. It plans to fully end its reliance on Russian gas by 2027, including through accelerated deployment of clean energy.[21]

In addition to de-coupling from Russia in terms of energy imports, the EU is increasingly concerned about its economic security and competitiveness in the clean energy technologies where China globally dominates. In other words, despite China and the EU's mutual interest in energy transition, clean energy supply chains have become a source of friction rather than cooperation between them. The EU and its member states have been making efforts to protect their markets and strategic industries—including clean energy supply chains—with their tactics extending to 'de-risking' from the Chinese economy and diversifying their economic partnerships.[22] This is also spreading into competition in other countries, for both clean energy markets and transition-related critical minerals. Provisions embedded in the EU's 2024 Critical Raw Materials Act seek to address some of the EU's trade vulnerabilities through benchmarks for domestic production, recycling and diversification of suppliers for transition-related critical minerals.[23]

Meanwhile, countries such as Russia with a significant reliance on revenues from export of hydrocarbons consider energy transition to be an economic threat. Russia has long been one of the world's leading exporters of oil and natural gas, with revenues from these sales providing 30–50 per cent of government revenue and 20 per cent of its GDP on average.[24] Fossil fuels have a determinative influence on its domestic as well as foreign policy—and this includes enabling its military aggression abroad.[25] Indeed, Russia has strengthened its commitment to hydrocarbon-based economic development: its energy strategy for the period up to 2050 envisages an increase in its oil exports to 540 million tonnes by 2030 (up from 531 million tonnes in 2023) and continuing at this level for the following two decades.[26] The goals also include the expansion of natural

[18] Baskaran, G. and Schwartz, M., 'China imposes its most stringent critical minerals export restrictions yet amidst escalating U.S.–China tech war', Center for Strategic and International Studies (CSIS), 4 Dec. 2024.

[19] Eurostat, 'Energy statistics—An overview', May 2025.

[20] European Commission, Directorate-General for Climate Action, 'European Climate Law', [n.d.]; and European Commission, Reform and Investment Task Force, 'Green transition', [n.d.].

[21] European Commission, 'Roadmap towards ending Russian energy imports', Communication to the European Parliament et al., COM(2025) 440 final, 6 May 2025.

[22] E.g. Zhou, J., Su, F. and Yuan, J., 'De-risking: The EU's and Japan's approaches to managing economic relations with China', SIPRI Research Policy Paper, Feb. 2024.

[23] Regulation (EU) 2024/1252 of the European Parliament and of the Council of 11 April 2024 establishing a framework for ensuring a secure and sustainable supply of critical raw materials (Critical Raw Materials Act), *Official Journal of the European Union* L, 3 May 2024.

[24] Yermakov, V., 'Follow the money: Understanding Russia's oil and gas revenues', Oxford Institute for Energy Studies (OIES), Mar. 2024.

[25] Cooper, J., 'Preparing for a fourth year of war: Military spending in Russia's budget for 2025', SIPRI Insights on Peace and Security no. 2025/04, Apr. 2025.

[26] Russian Government Decree no. 908-p, 'Энергетической стратегии Российской Федерации на период до 2050 года' [Energy strategy of the Russian Federation for the period up to 2050], 12 Apr. 2025.

gas and even coal production. In the short-to-medium term, a declining global supply market for oil and natural gas—accompanied by the exit of other exporters—may mean higher international prices for hydrocarbons, to the benefit of Russia.[27] This has already proved to be the case following its full-scale invasion of Ukraine, as higher global energy prices have contributed to profits despite sanctions against its energy sector.[28] Also of note for the global energy transition, Russia is a major exporter of enriched uranium and the world's leading exporter of civilian nuclear reactors.[29]

The United States' interest in energy transition has been highly volatile, marked by dramatic policy reversals. However, since early 2025 the US government has largely shared the Russian perspective. Political and financial commitments made in 2021–24 for energy transition at home and abroad have been abrogated in the second term of President Donald J. Trump. In January 2025 the USA announced its withdrawn (for a second time) from the Paris Agreement (with effect from January 2026).[30] Dependence on energy imports has long been a driver of US foreign policy, but since 2020 the USA has been a net exporter.[31] The USA is now the world's largest producer of oil and gas and the largest exporter of natural gas. In 2024 the USA accounted for about one-quarter of global investments in fossil fuels; this figure is set to rise with the Trump administration's re-prioritization of fossil fuel as central to its energy mix.[32]

Indeed, as a matter of official policy, the USA is making increasing use of its economic and political clout to expand its global market share in the fossil fuels trade.[33] This is important since, as the world's largest economy with the largest influence in the Bretton Woods system of monetary management (the International Monetary Fund and the World Bank), US influence crosses nearly all economic domains. Already by 2024, the USA had imposed three times as many economic sanctions as the next country, with significant impact on global energy markets and on broader trade and investment patterns.[34] Since early 2025, the use of tools of economic coercion, including tariffs, has only accelerated.

In relation to climate and geopolitical interests, alignments are thus highly mixed. This is further complicated by the ongoing interdependencies between the great powers. For example, while the EU has reduced its oil and natural gas dependence on Russia since the full-scale invasion of Ukraine in early 2022, it continues to be highly reliant on Russian uranium fuel products for its nuclear power plants.[35] Simultaneously, the EU's imports of liquefied natural gas (LNG) from the USA have grown significantly.[36] China, as the largest purchaser of Russian fossil fuel since the full-scale invasion, has also benefited from Western sanctions on Russian energy exports.[37] Meanwhile, the

[27] Bordoff, J. and O'Sullivan, M. L., 'Green upheaval: The new geopolitics of energy', *Foreign Affairs*, Jan/Feb 2022.

[28] Hilgenstock, B., 'What effects have energy sanctions had on Russia's ability to wage war?', Economics Observatory, 7 Aug. 2025.

[29] Schepers, N., 'Russia's nuclear energy exports: Status, prospects and implications', Non-proliferation and Disarmament Papers no. 61, EU Non-proliferation and Disarmament Consortium, Feb. 2019.

[30] United Nations, 'Paris Agreement—United States of America: Withdrawal', Depositary Notification no. C.N.71.2025.TREATIES-XXVII.7.d, 27 Jan. 2025.

[31] Council on Foreign Relations, 'v', [n.d.]; and US Energy Information Administration (EIA), 'US crude oil exporters reached a new record in 2024', 10 Apr. 2025.

[32] International Energy Agency (note 7), p. 185. International Energy Agency (IEA), World Energy Investments 2025 (IEA: Paris, June 2025).

[33] Friedman, L., 'Trump, with tariffs and threats, tries to strong-arm nations to retreat on climate goals', *New York Times*, 27 Aug. 2025.

[34] Kumleben, N., Luck, P. and Palazzi, A.L., 'Do sanctions work?', Back & Forth no. 3, Center for Strategic and International Studies (CSIS), 19 Mar. 2025.

[35] Sadouki, F., 'EU still dependent on Russian nuclear fuel—expert', Montel News, 6 Feb. 2025.

[36] Institute for Energy Economics and Financial Analysis, 'European LNG tracker', Oct. 2025.

[37] Katinas, P., 'August 2025—Monthly analysis of Russian fossil fuel exports and sanctions', Centre for Research on Energy and Clean Air (CREA), 10 Sep. 2025.

EU, Russia and the USA are all reliant on China for the majority of the processing of mineral inputs into their clean energy as well as other advanced technological supply chains.[38]

These interdependencies both give the great powers leverage and expose them to vulnerabilities against each other. These are increasingly being exploited and counteracted through tariffs, sanctions, import restrictions, export controls and other instruments of economic statecraft. This division and fragmentation of major markets also has a negative impact on energy transition.[39] It undermines the efficiency of global supply chains, thereby raising the cost and slowing the pace of the transition at national and global levels.[40] For example, fragmentation of mineral markets magnifies shocks that could otherwise be buffered in a wider market, and so drives up costs and volatility. It can also have a negative impact on commodity exporters—particularly those that are also developing countries.[41] In fact, an essential point is that, although the great powers are pursuing self-sufficiency policies, each remains deeply entangled in wider dependencies that are set to continue. For example, an important element of the great power competition now lies in incorporating resource-rich developing countries and middle powers into competing production networks for clean energy technologies.

In addition, recent geopolitical developments are displacing attention and resources from global environmental and climate objectives. Prior to 2025, elements of this great power competition were in part being channelled towards a more virtuous feedback loop, or a race to the top. This included committing greater amounts of climate financing and clean energy investments to emerging and developing markets, with promises of higher environmental, social and governance (ESG) standards—and with developmental principles at their core.[42] However, these dynamics are undergoing significant reversals, due in part to policy changes in the USA—previously the largest development donor and a champion of higher ESG standards, but which has drastically reduced its interest and footprint in both areas. Mercantilist deals have become more commonplace; two minerals deals signed by the USA in 2025, with Ukraine and the Democratic Republic of the Congo (DRC), were in the negotiations more focused on more transactional benefits for US mineral security.[43] These examples show how access to critical minerals is being instrumentalized as part of wartime support packages and as a lever within peace processes or ceasefire negotiations. As geopolitical rivalry intensifies, transition-related development finance may overall be reduced, undermining the ability of countries with limited capital or technology access to pursue their own energy transitions.

[38] Zhou and Månberger (note 17).

[39] Pitterle, I. and Vergara, S., 'Leveraging critical energy transition minerals: Policy pathways for sustainable development', UN Department of Economic and Social Affairs (DESA) Policy Brief no. 171, Feb. 2025.

[40] European Commission, *The Future of European Competitiveness*, part A, *A Competitiveness Strategy for Europe* (Publications Office of the European Union: Luxembourg, Sep. 2024), p. 41; and Alvarez, J., Andaloussi, M. B. and Stuermer, M., 'Geopolitical fragmentation threatens food security and clean energy transition', International Monetary Fund (IMF), 3 Oct. 2023.

[41] International Monetary Fund (IMF), *World Economic Outlook: Navigating Global Divergences* (IMF: Washington, DC, Oct. 2023), p. 73.

[42] Zhou, J. and Zha, D., 'Climate finance and geopolitics: The US–China factor', SIPRI, 28 Nov. 2023.

[43] Currier, A. and Mousseau, F., *Shafted: The Scramble for Critical Minerals in the DRC* (Oakland Institute: Oakland, CA, 2025); and Ukraine–US Agreement on the Establishment of a United States–Ukraine Reconstruction Investment Fund, signed 30 Apr. 2025, entered into force 23 May 2025, US Department of State Treaties and Other International Acts Series no. 25-523.

Middle powers and developing economies

Great power competition sets important boundaries for the rest of the world, given that the finance, the technology and the industrial capacity for clean technologies are often more limited outside advanced industrialized countries and China. This places most other countries in relationships of greater external dependency for energy transition. The divide is especially marked between the Global North and the Global South: while states in the former often frame renewable energy as a matter of industrial policy and geoeconomic competitiveness, the states of the latter often view energy transition as an important pathway to basic energy access and economic development.[44]

For middle powers and developing economies, the geopolitics of energy transition presents both perils and opportunities. Clean energy can, and most probably will, result in more distributed and self-sufficient systems, which promises a more symmetrical landscape of energy production and consumption.[45] This redistribution of energy capacity could, in principle, reduce global asymmetries if it is supported by inclusive governance and fair access to finance.

Energy transition is creating opportunities for a new set of actors different from those of the hydrocarbon era. For example, growing demand for transition-related critical minerals provides economic opportunities and levers for resource-rich countries, whose choices will thus also influence the global energy order.[46] The global distribution of reserves for critical minerals, which is far more concentrated even than hydrocarbons, can allow some countries to balance competing investors and to negotiate better terms for local processing and technology transfer. Amid great power competition, some states are finding more, rather than less, space for more sovereign political and economic decision-making.

Yet, the extent to which middle powers benefit from these openings depends heavily on governance capacity. Where regulatory institutions are weak, or where corruption or elite capture affects the energy and extractives sectors, new mineral or green energy investments can entrench rather than alleviate structural dependence.[47]

However, it is important to note that dependence on the mining sector rarely aligns with, or translates into, sustainable development for developing countries. Most of the countries with the greatest reliance on mining are low- and middle-income economies, and 88 per cent of the top 25 are in the lower half of the Sustainable Development Index.[48] Changing demand and strategies linked to energy transition are reshaping global extractive hierarchies and could deepen, rather than alleviate, structural dependence. This is particularly the case as extractive commodities sit low on value chains. There are also risks of an intensified 'resource curse', with consequences that include overreliance on extractive industries, lack of economic diversification, low productivity, slower economic growth, widening inequalities, environmental degradation and a higher risk of conflict.[49]

[44] Scholten, D., 'The power of energy: The geopolitics of the energy transition', E-international Relations, 17 June 2024.

[45] Scholten (note 44).

[46] Hendrix, C. and Bazilian, M., 'Raw power: Global South can leverage the critical minerals race', Modern Diplomacy, 3 Aug. 2025.

[47] Middelanis, M., Fritz, B. and de Paula, L. F., 'The Global South in the energy transition: A framework for industrial policy options to avert "greening dependency"', *Journal of Globalization and Development*, published online 4 Nov. 2025.

[48] International Council on Mining and Metals (ICMM), *Mining Contribution Index*, 7th edn (ICMM: London, Oct. 2025), p. 15.

[49] Magalhães Teixeira, B., 'Subdesenvolvimento, extrativismo e conflito no Sul Global e o papel de alternativas sistêmicas' [Underdevelopment, extractivism, and conflict in the Global South and the role of systemic alternatives], *Conjuntura Austral*, vol. 12, no. 59 (July/Sep. 2021).

Several mineral-rich states are moving to convert their resource endowments into broader developmental gains. Indonesia has restricted exports of raw nickel and requires domestic refining and processing facilities, in an effort to embed resource control within industrial policy to capture more value through battery production.[50] Chile's national lithium strategy has expanded state involvement and ties revenues directly to social programmes.[51] In Southern Africa, the DRC and Zambia have launched plans for regional battery manufacturing to move beyond raw material exports.[52] These initiatives show how resource-rich states are attempting to catalyse industrialization, employment and financial stability.[53] However, without institutional capacity, environmental safeguards or inclusive governance, extractive development strategies could risk sliding into a new form of 'green extractivism' that replicates the inequalities of the fossil fuel era.[54]

Beyond the politics of mineral resources, wider emergent political coalitions are also shaping the geopolitical landscape for energy transition. Countries such as Brazil, India and South Africa are leveraging their membership of BRICS (established by Brazil, Russia, India, China and South Africa) to increase political capital, attract finance and advance their own development agendas. These countries have sought to use coalition-building and an expansion of the group to amplify their influence on global negotiations and financing frameworks, thereby promoting alternative climate geopolitics.[55] Institutional innovations such as the New Development Bank, which was established by BRICS in 2015 and is currently expanding, illustrates this trend. The bank has pledged to direct 40 per cent of its portfolio to energy transition by 2026, providing a platform for middle powers to influence norms and financing priorities.[56] Individually, these three countries project their national strategies into global debates in different ways: India links renewable energy to industrial policy and South–South cooperation;[57] Brazil frames climate action as a development issue through biofuels and hydropower;[58] and South Africa has mobilized multibillion-dollar commitments through its Just Energy Transition Partnership with Western states.[59] Together, these efforts demonstrate how middle powers position themselves not only as recipients of climate finance but also as norm entrepreneurs that shape the meaning of energy transition.

For fragile and conflict-affected countries, energy transition also presents distinct opportunities and risks. In places where central provision of essential services has collapsed, such as Somalia and Yemen, decentralized renewable energy systems have

[50] International Energy Agency (IEA), 'Prohibition of the export of nickel ore', 19 Mar. 2024; and Azayaka Huda, A., Bridle, R. and Suharsono, A., 'Indonesian electric vehicle boom: Temporary trend or long-term vision?', International Institute for Sustainable Development (IISD), 12 Sept. 2024.

[51] Chilean Government, *National Lithium Strategy: For Chile and its People* (Chilean Government: Santiago, [2023]).

[52] Mususa, P. and Lutandula, M. S., *A Battery Industry in the Central African Copperbelt? Regional and Geopolitical Dimensions* (African Policy Research Institute: Oct. 2024).

[53] Hendrix and Bazilian (note 46).

[54] Magalhães Teixeira, B. and Oliveira, M. P., 'We are not Lithium Valley!', *NACLA Report on the Americas*, vol. 57, no. 3 (fall 2025).

[55] Brazil's 2025 Presidency of BRICS, 'BRICS proposes new climate geopolitics focused on financing and social justice', 3 Apr. 2025.

[56] Rodriguez, M. E. et al., *The Contributions of the New Development Bank to the Energy Transition Process of BRICS Countries (20162023)* (BRICS Policy Center: Dec. 2023).

[57] Naik, M. and Subramanian, M., 'The role of industrial parks in India's clean energy transition', World Economic Forum, 23 July 2025.

[58] de Oliveira Bredariol, T., 'Brazil's opportunity to lead the global dialogue on energy and climate', International Energy Agency (IEA), 18 July 2024.

[59] Tamasiga, P. and Sokona, Y., 'Financing South Africa's energy transition: Making the just aspects count more', Ukâmâ, Mar. 2025.

been deployed to sustain those services.[60] These projects demonstrate the opportunity of renewables to provide immediate resilience and humanitarian relief. However, there remain issues of long-term donor dependency. Without investment in governance and local capacity, the deployment of renewable energy does not necessarily strengthen state legitimacy or sovereignty.

Taken together, these dynamics show that the geopolitics of the green transition can redistribute agency in new ways that differ from the fossil fuel order. Nevertheless, the central challenge for middle powers and developing economies is to convert short-term openings into durable capabilities, thereby ensuring that new energy and mineral opportunities reinforce, rather than undermine, political and economic sovereignty. As laid out above, resource-rich countries can climb value chains with targeted industrial policy; middle powers can amplify influence through coalitions; and conflict-affected states can use decentralized renewables to govern amid disruption.

The case of Ukraine embodies many of these tensions in their most acute form. Situated at the intersection of European and post-Soviet energy systems, it faces the dual challenge of achieving energy sovereignty and navigating geopolitical confrontation. The dynamics outlined above, between dependence and diversification, vulnerability and agency, take on a sharper form in Ukraine. Its ongoing struggle to decouple from Russia while integrating with the institutions of the EU and the wider West captures both the constraints and the transformative potential of energy transition under conditions of war and insecurity.

[60] UN Office for Project Services (UNOPS), 'Beyond the grid: Powering communities across Yemen', [n.d.]; and Böhle, A.-S. and Tarif, K., 'Solar power and environmental peacebuilding in south-central Somalia', SIPRI Policy Brief, Feb. 2025.

3. Ukraine at the centre of multiple transitions

Ukraine's place in wider energy and geopolitical networks has long been at the centre of difficult questions related to its national sovereignty and security. While independence in 1991 created a nominally national energy market, Ukraine's energy infrastructure was still embedded in the unified Soviet power system and it remained highly dependent on Russia. Into the 2010s Russia was Ukraine's primary supplier of energy in the form of natural gas, oil, coal and even nuclear fuel.[61] These flows were both the cause and a casualty of several rounds of dispute between the two countries in the 2000s.[62] Such disputes, including energy blackmail, have been a running feature of post-Soviet energy politics.[63] In the case of Ukraine, this was exacerbated by it serving as the main transit country for the supply of Russian natural gas to Central and Western Europe. As later chapters show, these long-standing vulnerabilities now intersect with the perils and promise of energy transition, placing Ukraine at the heart of emerging green geopolitics.

Throughout the 21st century, Ukraine's efforts to disentangle its energy ties with Russia have reflected its wider efforts to achieve greater political sovereignty from Russia. Ukrainian governments have been explicit that the strategic goal of greater independence from Russia requires diversification of energy suppliers, import substitution and the development of alternative energy sources.[64] After Russia's annexation of Crimea and the start of the war in the Donbas region in 2014, Ukraine stopped directly buying natural gas from Russia.[65] However, as a sign of the complexity of energy ties, and of the durability of natural gas transit pipeline contracts in particular, Ukraine continued to transit Russian natural gas to Central and Western Europe until the end of 2024, nearly three years after Russia's full-scale invasion.[66]

Over the years, Ukraine's quest for political and energy independence has become increasingly linked to its energy transition. Climate action, energy efficiency and environmental sustainability have become particularly important in the context of Ukraine's ambitions to integrate with the European Union. Ukraine joined the EU's Energy Community in 2011 and in 2014 it signed an association agreement with the EU that committed Ukraine to adopting the EU energy *acquis* in its entirety (i.e. the EU's accumulated legislation, legal acts and court decisions).[67] The Energy Security Strategy adopted by Ukraine in 2021 is explicit that 'energy security is inextricably linked to the success of European integration, the synchronization of energy systems and markets with European ones, and the sector's sustainable development'.[68] However, barriers to transition have been significant: Ukraine has one of the most carbon- and energy-intensive economies in the world, and it retains a Soviet legacy of heavy industry and a political economy significantly dependent on production and consumption of fossil fuels.[69]

[61] Balmaceda, M. M., 'Gas, oil and the linkages between domestic and foreign policies: The case of Ukraine', *Europe-Asia Studies*, vol. 50, no. 2 (Mar. 1998).

[62] Filippenko, K., 'A timeline of major events in Ukraine–Russia gas relations', Wood Mackenzie, 20 Dec. 2019.

[63] Siddi, M., 'The role of power in EU–Russia energy relations: The interplay between markets and geopolitics', eds V. Akchurina and V. Della Sala, *The European Union, Russia and the Post-Soviet Space: Shared Neighbourhood, Battleground or Transit Zone on the New Silk Road?* (Routledge: New York, 2022).

[64] Ukrainian Cabinet of Ministers Decree no. 605-p, 'Енергетична Стратегія України на Період до 2035 року: «Безпека, енергоефективність, конкурентоспроможність»' [Ukraine's energy strategy for the period up to 2035: 'Security, energy efficiency, competitiveness'], 18 Aug. 2017; and Ukrainian Cabinet of Ministers Decree no. 907-p, 'Стратегія енергетичної безпеки' [Energy security strategy], 4 Aug. 2021.

[65] 'Ukraine to stop buying Russian gas from April 1—energy minister', Reuters, 23 Mar. 2015.

[66] 'Russian gas flows via Ukraine for last days as transit deal crumbles', Reuters, 30 Dec. 2024.

[67] Energy Community Treaty, *Official Journal of the European Union*, L 198, 20 July 2006; and Association Agreement between the European Union and its Member States, of the one part, and Ukraine, of the other part, signed 21 Mar. and 27 June 2014, entered into force 1 Sep. 2017, *Official Journal of the European Union*, L 161, 29 May 2014.

[68] Ukrainian Cabinet of Ministers Decree no. 907-p (note 64) (author translation).

[69] Doronina, I. et al. (2024), 'Why renewables should be at the center of rebuilding the Ukrainian electricity system', *Joule*, vol. 8, no. 10 (Oct. 2024); and Ukraine Invest, 'Investment opportunity of energy sector', [2024].

Russia's full-scale invasion initially postponed many of Ukraine's energy transition policies. However, as climate, economic and national security priorities have become more interlinked than ever, there has since been a renewed urgency to and acceleration of transition policies. In June 2024 Ukraine adopted an umbrella National Energy and Climate Plan (NECP) for the period to 2030 that brings its climate and energy policy priorities in line with EU regulations.[70] Transition targets now include the production of 27 per cent of final energy consumption from renewable sources by 2030, 70 per cent by 2050 and the phasing out of coal by 2035. In October 2024 Ukraine also adopted the law 'On the Basic Principles of the State Climate Policy', an obligation under its EU association agreement and the Paris Agreement.[71] The law enshrines the net zero target of 2050. These targets illustrate both the promise of accelerated modernization and the challenge of delivering far-reaching reforms under conditions of war, financial strain and institutional capacity constraints.

As the following sections detail, there are currently several interrelated drivers of energy transition in Ukraine. These include immediate war-related problems of electricity generation; the imperative of reorienting the country's political, economic and energy systems towards the EU; and the longer-term desire to 'build back better' in ways that ensure future economic competitiveness. All these goals are, in turn, efforts to achieve and maintain national security, sovereignty and geopolitical autonomy in addition to economic transformation. In this respect, energy transition relates to many issues at the heart of the conflict itself.

For the following analysis it is important to note that, although many factors impose limits on Ukraine's energy transition—from lack of financing to hard realities of implementation—lack of physical potential is not among them. Ukraine has wind and solar energy potential that far exceeds pre-2022 overall generation capacity, which was already sufficient for net export.[72] This makes Ukraine's NECP targets more than feasible in theory. However, a significant proportion of this potential is currently in occupied or mine-contaminated regions.[73] In addition to renewable energy, the Ukrainian government is also prioritizing nuclear power, bioenergy and hydrogen generation.[74] However, realizing this potential will depend less on resource endowments than on governance, investment and the wider geopolitical conditions under which reconstruction takes place.

Energy security and war-related considerations

Even before its full-scale invasion, Russia had seized significant Ukrainian energy resources and assets. A substantial portion of Ukraine's generation capacity was in the eastern territories that were affected by military activity or occupied by Russia

[70] Ukrainian Ministry of Economy, 'Ukraine approves National Energy and Climate Plan on the day of the start of EU accession negotiations', 25 June 2024; and National Energy and Climate Plan for the period until 2030, Approved by Ukrainian Cabinet of Ministers Decree no. 587-p, 25 June 2024, English translation by Energy Community Secretariat.

[71] Ukrainian Law no. 3991-IX 'Про основні засади державної кліматичної політики' [On the basic principles of state climate policy], *Bulletin of the Verkhovna Rada*, 8 Oct. 2024. See also Ukrainian Climate Office, 'Ukraine adopts Climate Law, paving the way for climate neutrality by 2050', 8 Oct. 2024.

[72] Doronina et al. (note 69).

[73] Doronina et al. (note 69) Doronina, I. et al. (2024), 'Why renewables should be at the center of rebuilding the Ukrainian electricity system', *Joule*, vol. 8, no. 10 (Oct. 2024); and International Energy Agency (IEA), *Empowering Ukraine Through a Decentralised Electricity System A Roadmap for Ukraine's Increased Use of Distributed Energy Resources towards 2030* (IEA: Paris, Dec. 2024).

[74] International Energy Agency (IEA), *Unlocking Ukraine's Hydrogen Opportunity: A Roadmap* (IEA: Paris, Mar. 2025); Energoatom, 'Ukraine is developing nuclear power despite the war', 21 Mar. 2024; and European Bank for Reconstruction and Development (EBRD), 'EBRD to lend €60 million for its first wartime biofuels finance in Ukraine', 12 June 2024.

from 2014.[75] Since February 2022 Ukraine has dealt with not only an even greater appropriation of territory and resources, but also the targeted destruction of its energy system.

By the end of 2024, Russia had occupied, damaged or destroyed two-thirds of Ukraine's capacity for dispatchable power generation (i.e. capacity that can adjust power output as demand changes).[76] This included the Zaporizhzhia Nuclear Power Plant—the largest in Europe—which alone provided one-third of Ukraine's energy needs prior to the war. All of Ukraine's large-scale centralized power plants have been attacked since 2022.[77] The attacks—both cyberattacks and physical bombardment—have extended to transmission infrastructure and other energy facilities.[78] Industrial energy demand in Ukraine has declined in part due to the war, but the power deficit was still one-third of peak demand in mid-2024.[79] Since then, Ukraine has restored and added new capacity, but faces continual and even escalating attacks on its energy system into the winter of 2025–26.[80] More acutely, the Ukrainian population has faced continual power shortages and outages, including for winter heating. Russia's destructive tactics, which form part of its general, civilian-targeting warfare, also serve to disrupt Ukraine's economy and to remove a competitor from regional energy markets.[81] Repairing and protecting critical generation and transmission infrastructure remain ongoing tasks to address immediate energy deficits.

War conditions present unique constraints on Ukraine's energy strategy. It has been forced to import coal to bridge shortfalls at various points, underscoring how fossil fuels remain a fallback in times of crisis.[82] If prolonged or expanded, however, such emergency measures risk locking in new fossil fuel dependencies that run counter to longer-term decarbonization goals. However, renewable energy systems are, in fact, uniquely suited for wartime conditions and requirements for a number of reasons: they can be constructed and deployed more quickly than conventional large-scale systems; and their modular, decentralized nature reduces their target value and the negative impact on wider systems of their destruction. While this gives them resilience to military attacks, they are still affected: up to 75 per cent of renewables infrastructure has reportedly suffered some degree of damage during the war.[83] This has worsened as Russia has switched to more focused attacks against local energy infrastructure in the second half of 2025.[84]

However, it is still the case that renewable units can also be repaired more quickly than large-scale plants. They can operate independently during emergency situations and can be sited close to demand centres, for example to support critical infrastructure. These features are shared with small modular gas turbines and diesel generators, although these have high environmental and fuel costs and have more limited value for long-term energy security.[85] Finally, at the same time as they reduce energy

[75] Doronina et al. (note 69).
[76] International Energy Agency (note 73).
[77] Doronina et al. (note 69).
[78] International Energy Agency (note 73).
[79] International Energy Agency (IEA), *Ukraine's Energy Security and the Coming Winter: An Energy Action Plan for Ukraine and Its Partners* (IEA: Paris, Sep. 2025).
[80] International Energy Agency (IEA), *Ukraine's Energy Security: A Pre-winter Assessment* (IEA: Paris, Oct. 2025).
[81] Polishchuk, O. and Gurcov, N., 'Bombing into submission: Russian targeting of civilians and infrastructure in Ukraine', Armed Conflict Location & Event Data (ACLED), 21 Feb. 2025.
[82] Dixi Group, 'How much Ukraine spent on energy resources imports in the third year of the full-scale war', 25 Feb. 2025.
[83] Ukraine Invest (note 69).
[84] Tril, M., 'Not random anymore—Russia targets Ukraine's power and gas by region, Energy Ministry says', Euromaiden, 20 Oct. 2025.
[85] International Energy Agency (note 73).

costs, renewables increase self-sufficiency in terms of fuels. Moreover, supply chains for renewables technologies are also largely independent of Russia. In this sense, investments in renewables are not only crisis responses but also shape longer-term trajectories of energy sovereignty and geopolitical resilience.

The International Energy Agency (IEA) assesses that a combination of renewables and small modular gas turbines—which prevent overinvestment in larger-scale fossil fuel-based systems—can support long-term decarbonization goals and energy strategies while effectively meeting immediate power system needs in Ukraine.[86] However, variations in generation output and in demand still require balancing through dispatchable baseload power. Prior to the full-scale invasion, this baseload was provided largely by coal-fired power stations and large-scale nuclear plants. Currently, around half of Ukraine's energy supply is provided by nuclear power plants in the west and centre of the country.[87] Over the long term, greater reliance on renewables will require significant system flexibility through more electricity storage, transmission, distribution and grid infrastructure.[88]

Geopolitical reorientation and EU accession

Beyond immediate war-related concerns, Ukraine's energy transition is also about the reorientation of its energy relations with the West—including physical and political integration with the EU in particular.

In terms of physical integration, Ukraine was previously connected to the Russian power grid but launched a disconnection test on 24 February 2022—the day that Russia's invasion began.[89] Three weeks later Ukraine synchronized with the Continental European electricity grid, which covers much of Central and Western Europe. In early 2025 the European Commission announced a support package for the full coupling of Ukraine's electricity market with the EU by early 2027.[90] Physical interconnection to the EU allows for electricity imports, grid balancing, and current and future exports. As well as enhancing the resilience of Ukraine's energy system and economy against external pressure and incidental supply disruptions, it is also deeply tied to geopolitical resilience. This forms part of the 'overall security guarantees' that integration with the EU will provide against Russian coercion.[91] These developments illustrate how energy infrastructure and markets are becoming central instruments of green geopolitics, with security as well as climate implications.

Legislative, regulatory and market integration with the EU entails significant reform—not least in terms of energy efficiency and decarbonization.[92] Tellingly, the Ukrainian government approved its NECP on the same day in June 2024 that accession negotiations with the EU began.[93] However, war priorities mean that limited resources are available, including for implementing the difficult policy and industry reforms demanded of Ukraine. For example, it has not yet introduced an emissions trading system (ETS) aligned with the EU. Establishment of an ETS is now mandated by the

[86] International Energy Agency (note 73).

[87] International Energy Agency (note 80).

[88] International Energy Agency (note 73).

[89] European Network of Transmission System Operators for Electricity (ENTSO-E), 'Continental Europe successful synchronisation with Ukraine and Moldova power systems', 16 Mar. 2022.

[90] European Commission, 'Commission steps up support for Ukraine's energy security and paves the way for full market integration', Press release, 24 Feb. 2025.

[91] European Commission (note 90).

[92] Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, *Official Journal of the European Union*, L 328, 21 Dec. 2018.

[93] Ukrainian Ministry of Economy, 'Ukraine approves National Energy and Climate Plan on the day of the start of EU accession negotiations', 25 June 2024.

2024 Climate Law, but implementation has been delayed by wartime conditions; the ETS is planned to be fully working by 2028.[94] The timing is significant since Ukraine—with its economic structure, dependent on carbon-intensive sectors (e.g. cement, iron and steel production)—will be among the countries most economically affected by the EU's Carbon Border Adjustment Mechanism (CBAM) when it enters into force in 2026.[95] However, Ukraine plans to seek a war-based exception from the CBAM. In the absence of such measures, EU decarbonization tools designed to strengthen global climate ambition could also deepen short-term economic pressure on Ukraine's export sectors.

EU accession-related reforms also go well beyond the energy sector to include a wide-range of governance reforms for the wider transformation of Ukraine's economy and its institutions.[96] Recent scandals related to corruption in and beyond the energy sector not only place Ukraine's progress towards EU accession into question but may also put external financial support for Ukraine at risk.

'Building back better' and future economic competitiveness

The aim of EU integration provides a policy framework for Ukraine to bridge immediate war-related imperatives with long-term goals for a more modernized, sustainable and resilient economy. The most recent Rapid Damage and Needs Assessment (RDNA4)—a joint assessment by the Ukrainian government, the EU, the United Nations and the World Bank as of December 2024—estimates reconstruction needs at US$524 billion, of which the energy and extractive industries would require $68 billion.[97] These are already underestimates given ongoing destruction. Some funds for this reconstruction are being provided by external partners. The EU has a designated Ukraine Facility: a financial support mechanism for 2024–27 through which it channels support for the energy sector, among other things.[98] An estimated €2 billion ($2.2 billion) has already been provided to support Ukraine's energy security via various channels.

However, with energy transition at the centre, the damage and destruction of energy assets is also considered an opportunity to 'build back better'. This concept is at the heart of reconstruction plans that have been developed and are being implemented by the Ukrainian government in conjunction with civil society and international partners.[99] Ukraine's goals include not only greater energy resilience but also development of its energy export potential. This includes clean electricity generation, biofuels and green hydrogen.[100] For example, in January 2025 the Gas Transmission System Operator of Ukraine (GTSOU) signed a memorandum of understanding with several Central and West European operators and companies to create a hydrogen-supply corridor that repurposes existing gas pipelines and infrastructure.[101]

[94] Ukrainian Cabinet of Ministers Decree no. 146-p, 'Про затвердження плану заходів щодо створення національної системи торгівлі квотами на викиди парникових газів' [On approval of the action plan for the creation of a national greenhouse gas emissions trading system], 21 Feb. 2025; and Ukrainian Law no. 3991-IX (note 71), Article 17.

[95] Kolisnichenko, V., 'Ukraine has not yet approached the EU regarding a CBAM deferral—NAEIU', GMK Center, 1 Aug. 2025; and Chepeliev, M. et al., *CBAM's Effects on Ukraine's Economy and Its Decarbonization Effects* (Green Deal Ukraïna: Berlin, May 2025).

[96] European Commission, 'Ukraine 2025 report', Commission Staff Working Document, 4 Nov. 2025.

[97] World Bank et al., *Ukraine: Fourth Rapid Damage and Needs Assessment (RDNA4): February 2022–December 2024* (World Bank: Washington, DC, Feb. 2025), p. 40.

[98] Council of the EU, 'The Ukraine Facility', 4 Nov. 2025.

[99] E.g. Ukraine Recovery Conference, Rome, 10–11 July 2025. See also Build Ukraine Back Better Platform, 'Roadmap for the sustainable recovery of Ukraine', 2025.

[100] International Energy Agency (note 74); and European Bank of Reconstruction and Development (note 74).

[101] Gas Transmission System Operator of Ukraine, 'Memorandum signed on Ukraine–EU hydrogen corridor', 16 Jan. 2025.

However, Ukraine also has plans to participate in fossil fuel value chains. Its government hopes to capitalize on its substantial gas-storage capacity as part of future contributions to wider energy networks, which still rely on fossil fuel inputs. Ukraine has issued new licences for gas exploration, signalling policy continuity even as the government commits to targets to phase out natural gas.[102] Finally, export potential is also envisioned in the critical minerals sector, in support of Western supply chains for clean energy and other strategic technologies, for the EU and the USA in particular. In 2021 the EU and Ukraine signed a strategic partnership on raw materials, which aims to develop joint investment opportunities related to critical minerals.[103] A Ukrainian graphite-extraction project was also designated by the EU as a 'strategic project' under its 2024 Critical Raw Materials Act.[104] The April 2025 Ukraine–USA minerals deal includes establishment of a Reconstruction Investment Fund, to which revenue from and licences for extractives will contribute.[105]

While such arrangements can unlock much needed finance, they also risk reinforcing a model in which Ukraine's role is concentrated in extraction and storage, with uncertain prospects for domestic processing or manufacturing. It is not yet known how much value will be retained within Ukraine and without clear strategies for domestic value creation and strong governance, these initiatives could entrench Ukraine in low-value, high-risk segments of fossil fuel and mineral supply chains.

[102] Naftogaz, 'Naftogaz launches new high-yield producing 383,000 cubic meters of gas per day', 8 July 2025.

[103] European Commission, 'EU and Ukraine kick-start strategic partnership on raw materials', Press release, 13 July 2021.

[104] European Commission, 'Commission selects 13 strategic projects in third countries to secure access to raw materials and to support local value creation', Press release, 4 June 2025; and Regulation (EU) 2024/1252 (note 23).

[105] Zhou, J. and Gergun, A., 'Mineral spoils in Ukraine: A poor foundation for peace and recovery', SIPRI, 2 May 2025; and Ukraine–US Agreement on the Establishment of a United States–Ukraine Reconstruction Investment Fund (note 43).

4. Ukraine's transitions in the wider strategic environment

Ukraine's vision and agenda for its energy transition do not sit within a vacuum but interact with much wider international interests, both geopolitical and specifically energy related. These wider interests intersect, not least in the case of Russia, whose hydrocarbon revenues and global exports are tied to its active obstruction of Ukrainian security, sovereignty and sustainability. While the Russia factor is clear cut, the interests of other actors—including those within the wider economic and security networks which Ukraine is or seeks to become a part of—are not unified. In some cases these interests align with Ukraine's simultaneous energy and geopolitical transitions; in other cases they may work against them.

This chapter covers first the interests of Russia and the European Union as they specifically relate to Ukraine's transitions, before turning to a wider set of actors that are directly or tangentially involved. As it shows, Ukraine's transition is shaped not only by domestic ambition but by the broader dynamics of green geopolitics, where supply chains, strategic resources and security partnerships increasingly overlap.

The interests of Ukraine's near neighbours

Russia's destruction and disruption have obvious effects on Ukraine's energy transition, even as some dimensions of it accelerate. As noted above, Ukraine's highest potential for energy generation from renewable sources is located in its south and east, which are affected by military activity or have been occupied by Russia since 2014 or 2022.[106] Russia has also appropriated significant energy resources as part of its war strategy, impeding Ukraine's vision of contributing to EU and global energy markets.[107] Ukrainian territories occupied by Russia also include substantial energy resources as well as deposits of critical minerals. Russia's annexation of Crimea in 2014 already brought it both energy infrastructure on the peninsula and major offshore oil and natural gas reserves.[108] Russia subsequently also occupied most of Ukraine's largest coal-producing region, the Donbas, a territory that includes important mineral deposits and mineral-production centres. In addition, Russia's appropriation of Ukrainian resources forms part of its own foreign energy strategy by disrupting and diverting resources from a direct competitor to feed its own national supply chains; for example, Russia's mineral-development strategy of 2024 mandates 'The integration of the mineral-resource complexes of Donetsk People's Republic, Luhansk People's Republic, Zaporizhzhia oblast and Kherson oblast into the Russian economy', including both hydrocarbons and critical minerals.[109] This appropriation of energy and mineral assets is a stark example of how war, resource control and green geopolitics intersect, with direct implications for Ukraine's transition choices.

In terms of the further entanglement of energy transition issues and war interests, Russia's military activities continue to be financed by oil and natural gas rents.[110] Despite sanctions, global markets still channel significant revenues to the Russian

[106] Doronina et al. (note 69).

[107] Keypour, J. and Hendla, I., 'The annexation of Crimea: A realist look from the energy resources perspective', *Baltic Journal of European Studies*, vol. 9, no. 3 (Sep. 2019).

[108] Broad, W. J., 'In taking Crimea, Putin gains a sea of fuel reserves', *New York Times*, 17 May 2014.

[109] Russian Government Decree no. 1838-p, 'Стратегия развития минерально-сырьевой базы Российской Федерации до 2050 года' [Strategy for the development of the mineral resource base of the Russian Federation to 2050], 11 July 2024, section II (author translation).

[110] Cooper (note 25).

state.[111] Russian fossil fuel exports generated €242 billion ($262 billion) in revenue for its government in 2024, three years after its full-scale invasion of Ukraine—above pre-war levels.[112]

On the other side of the geographic and geopolitical divide is the European Union—a growing geopolitical force and security actor in its own right. EU and Ukrainian goals with respect to energy security and decarbonization are closely aligned. As noted above, the EU sees Ukraine as a potential partner in its clean energy supply chains, to diversify its mineral dependencies. But the EU also sees Ukraine's energy security as core to its own; it sees integration of Ukraine's energy market—including clean electricity and fuel generation—into the EU as enhancing its own energy security.[113]

The EU and Ukraine are also aligned on the issue of increasing pressure on the Russian hydrocarbon-industrial complex through sanctions and by reducing existing energy dependencies. The EU has taken steps to reduce its dependence through a strategy launched May 2022.[114] It has reduced the Russian share of its natural gas imports from 45 per cent in 2021 to 19 per cent in 2024, with further reductions in 2025.[115] Its 19th package of sanctions against Russia, approved in October 2025, sets more stringent measures to completely phase out the supply of Russian natural gas to the EU by the end of 2027.[116] In the nuclear power sector Russia supplied 38 per cent of the enriched uranium used in EU nuclear power plants as of 2023.[117] EU members using Russian-designed nuclear reactors are also working to replace Russian nuclear fuel.[118]

Nonetheless, the EU continues to have a degree of dependence on Russian oil, natural gas and nuclear material. This provides income to the Russian regime that both directly and indirectly funds war efforts. EU imports of Russian fossil fuels were valued at around €21.9 billion ($23.7 billion) in 2024, comparable to the €18.7 billion ($20.2 billion) financial aid that its member states sent to Ukraine that year.[119] This highlights not only the durability of energy relations, but also contradictions across levels of policymaking. Within the EU, for example, Hungary and Slovakia were granted exemptions from the wider EU phase-out of Russian oil and natural gas imports; they have actually increased their purchases since the full-scale invasion.[120] These internal divergences underscore how EU partners themselves face tensions between short-term energy security and longer-term decarbonization. These complicate Ukraine's efforts to align its transition with that of the wider bloc.

Such internal fractures have weaken EU resolve on external energy policies.[121] Weak enforcement of sanctions has also allowed for the continued import of Russian oil and natural gas supplies through intermediaries.[122] For example, Türkiye continues to import Russian natural gas, significant amounts of which flow into the EU and other states that have imposed sanctions on Russia.[123] The EU has tried to close these

[111] Raghunandan, V. et al., 'Three years of invasion: EU imports of Russian fossil fuels in third year of invasion surpass financial aid sent to Ukraine', Center for Research on Energy and Clean Air (CREA), Feb. 2025.

[112] Raghunandan et al. (note 111).

[113] European Commission (note 90).

[114] European Commission, 'REPowerEU: Affordable, secure and sustainable energy for Europe', [n.d.].

[115] European Commission (note 21).

[116] European Commission, 'EU adopts 19th package of sanctions against Russia', Press release, 23 Oct. 2025.

[117] Lapenko, O. et al., 'Ending European Union imports of Russian uranium', Breugel, 14 Apr. 2025.

[118] European Commission (note 21).

[119] Raghunandan et al. (note 111).

[120] Levi, I. et al., 'The last mile: Phasing out Russian oil and gas in Central Europe', Center for the Study of Democracy (CSD) and Center for Research on Energy and Clean Air (CREA), May 2025.

[121] Levi et al. (note 120).

[122] Raghunandan et al. (note 111).

[123] Raghunandan, V. et al., 'Sanctions hypocrisy: G7+ imports EUR 1.8 bn of Turkish oil products made from Russian crude', Center for the Study of Democracy (CSD) and Center for Research on Energy and Clean Air (CREA), 17 Sep. 2024.

loopholes: in addition to the future ban on imports of Russian natural gas, in October 2025 the EU sanctioned two of its largest oil companies, Rosneft and Gazprom Neft.[124]

Energy security remains a key priority for the EU, but this does not always align with energy transition; coal-fired power stations have been reopened and new natural gas contracts signed in response to supply shocks.[125] In seeking to diversify its energy supplies and suppliers, the EU has also pivoted to alternative suppliers and supplies, including LNG from Australia, Qatar and the USA.[126] This illustrates the persistence of fossil fuels in energy security strategies.[127] LNG flows have notably been tied to broader political and economic bargains, with buyers of US exports pressured into longer-term contracts.[128] These developments reveal that, even within the EU, the promise of energy transition continues to compete with immediate energy security imperatives.

The EU is also examining alternative energy suppliers in its extended neighbourhood. This includes with Mediterranean countries, partners in the Black Sea region and energy-rich countries in the Caspian Sea region.[129] There may be potential elements of competition among proposed energy transit networks and suppliers—possibly affecting Ukraine's own export plans.

The EU also shows signs of backsliding on environmental ambitions, with climate priorities increasingly competing with hard security imperatives.[130] EU leaders also openly frame an 'era of rearmament'; 11 defence ministers of EU members reportedly asked the European Commission in 2025 to exempt military activities from emissions targets, citing concerns that environmental rules could obstruct combat readiness.[131] This illustrates how, even among Ukraine's closest partners, the balance between security and sustainability remains contested.

Extraregional interests

Divergence of interests extends far beyond Ukraine's immediate neighbourhood, to include other key global players that are shaping the Russia–Ukraine War.

Among these is the United States, which until the end of 2024 was a key supporter of Ukraine's military and political goals, including energy transition. However, under the new Trump administration, the picture is far more mixed. This includes an explicit downgrading of the war in Ukraine as a foreign policy priority, cuts to military and civilian aid to the country, and a much stronger appetite for negotiating with Russia if

[124] European Commission (note 116).

[125] Zimmermann, A., Guillot, L. and Folkman, V., 'Fossil fuel giant Norway pitches itself as Europe's ideal green partner', Politico, 23 Apr. 2025; and Amelang, S. et al., 'War in Ukraine: Tracking the impacts on German energy and climate policy', Clean Energy Wire, 24 Feb. 2023.

[126] Hernandez, A. and Rashad, M., 'US, Qatar to fill gap after EU bans Russian LNG imports', Reuters, 23 Oct. 2025.

[127] European Commission, 'EU–US trade deal explained—Energy aspects', 31 July 2025.

[128] Romanko, S. and Bollendorff, E., 'From dependence to resilience: Why the EU needs to stop importing LNG now and pivot to renewables for energy security and prosperity', Climate Action Network Europe, 28 Feb. 2025.

[129] European Commission, 'New EU strategy for secure, prosperous and resilient Black Sea region', Press release, 28 May 2025; European Commission, Directorate-General for Neighbourhood and Enlargement Negotiations, 'EU and Azerbaijan enhance bilateral relations, including energy cooperation', 18 July 2022; Standish, R., Jozwiak, R. and Senggirbay, M., 'EU readies new trade routes—and a challenge to Beijing and Moscow—at Luxembourg summit', Radio Free Europe/Radio Liberty, 20 Oct. 2025; and European Commission, Directorate-General for International Partnerships 'Southern hydrogen corridor connecting North Africa, Italy, Austria and Germany', [n.d.].

[130] Gayle, D., 'Europe's pledge to spend more on military will hurt climate and social programmes', *The Guardian*, 24 June 2025.

[131] European Commission, 'Press statement by President von der Leyen on the defence package', 4 Mar. 2025; and Barnes, J., 'Green rules "stop Europe preparing for Russian invasion"', *Daily Telegraph*, 5 June 2025.

not appeasing Russian demands.[132] In the energy sector, several programmes to support emergency and longer-term energy generation in Ukraine have been affected.[133]

The overall Ukrainian–US relationship has become more conditional and transactional, including in relation to Ukraine's extractives sector. In return for more limited but continued US support, the April 2025 minerals deal gives the USA preferential access to new resource exploitation in Ukraine.[134] The deal entails eventual sharing of profits from hydrocarbons and mineral projects.[135] It reflects a wider trend towards more mercantilist agreements in which resources become bargaining chips in conflict and peace negotiations. While the Trump administration is less interested in the clean energy applications of critical minerals, many of these minerals are also essential inputs for other strategic economic sectors and technologies. Meanwhile, the USA's hydrocarbon agenda is increasingly coupled to its negotiating positions in relation to Ukraine and to its interest in brokering a peace deal—but in contradictory and often unpredictable ways.

For example, in mid-2025 US officials tested reactions to the revival of the Russia–EU Nord Stream gas pipelines as an economic incentive for the Russian negotiators.[136] The USA has subsequently applied more pressure on Russia's hydrocarbon sector, targeting both international consumers as well as in October 2025 adding additional sanctions on Russia's two largest oil companies, Rosneft and Lukoil.[137] Structurally, Russia and the USA are competitors in export markets, as indicated in US diplomatic pressure on the EU to entirely replace Russian fossil fuel imports—largely with US supplies.[138] This pressure serves Ukrainian security interests in relation to Russia and, to some extent, serves the EU's energy-substitution goals. However, the link to US negotiating positions on the war also highlights how energy and geopolitical alignments are becoming more interest-based, transactional and less reliable. It also portends new hydrocarbon dependencies that could reduce autonomy for both the EU and Ukraine in the medium term.

Other states have distanced themselves from the immediate conflict but remain highly relevant from an overall strategic perspective. Globally, despite the range of sanctions imposed on Russian energy exports by the wider West, Russia has been able to remain one of the world's top exporters of oil and gas, largely by shifting its main consumer market from the EU to India, China, Türkiye and other countries in the Middle East.[139]

The role of China is of particular note due to the wider geopolitical and strategic implications of a China–Russia alignment for the EU, the USA and other Western countries. China serves as the main rival for overall Western efforts to diversify and domesticate supply chains in clean energy technologies, from critical raw materials to end-use products. This is also indirectly shaping the agendas of both the EU and the USA towards Ukraine. While there are some hopes that China could be a partner for Ukraine in reconstruction—including for energy transition processes—the Ukraine–

[132] Sanger, D. E., 'Trump offers a Ukraine peace plan the Kremlin can love', *New York Times*, 22 Nov. 2025.

[133] US Department of State, 'Energy security support to Ukraine', 29 Nov. 2022; and Hillyard, V., 'State Department terminates U.S. support of Ukraine energy grid restoration', NBC News, 28 Feb. 2025.

[134] Ukraine–US Agreement on the Establishment of a United States–Ukraine Reconstruction Investment Fund (note 43).

[135] Zhou and Gergun (note 105).

[136] Hirtenstein, A. and Rashad, M., 'US, Russia explore ways to restore Russian gas flows to Europe, sources say', Reuters, 8 May 2025.

[137] US Department of the Treasury, 'Treasury sanctions major Russian oil companies, calls on Moscow to immediately agree to ceasefire', Press release, 22 Oct. 2025.

[138] Joint Statement on a United States–European Union framework on an agreement on reciprocal, fair and balanced trade, 21 Aug. 2025.

[139] International Energy Agency (IEA), 'Russia's war on Ukraine: Analysing the impacts on energy markets and energy security', [2024].

USA minerals deal is an important limiting factor since it seemingly excludes China from participating in or profiting from Ukraine's natural resource and extractives sector.[140] This centrality of China in clean energy and mineral supply chains amplifies the geopolitical stakes of Ukraine's alignment choices, particularly as external financing options narrow and global rivalries intensify.

[140] The White House, 'President Donald J. Trump secures agreement to establish United States–Ukraine Reconstruction Investment Fund', Fact sheet, 1 May 2025.

5. Perils and promise of green geopolitics

Energy transition is unfolding in an international environment marked by fragmentation, great-power rivalry and contested supply chains. In this setting, energy policy is not merely a technical agenda but a strategic terrain where security, industrial policy and climate objectives collide. For Ukraine, the stakes are unusually high: war has made resilience a precondition for sovereignty; accession to the European Union has bound transition choices to a demanding *acquis*; and reconstruction has elevated energy systems to the core of economic renewal. However, the same dynamics that open opportunities—new technologies, critical mineral leverage and regional market integration—can also generate risks. Put differently, the transition's most significant gains remain a promise, rather than a guarantee, and these are conditional on how Ukraine navigates the geopolitical, economic and governance pressures that surround it.

This chapter examines many of the trade-offs that structure green geopolitics—with a particular emphasis on Ukraine. For Ukraine, the trade-offs can be particularly acute; however, the dilemmas that it faces are also more general and are faced by many middle powers and developing countries. In an era of geopolitical fragmentation, political and economic alignments remain necessary but are also fragile. Efforts to enter global clean energy supply chains are an economic opportunity, but they also create developmental risks. Moreover, competing priorities hinder coherent policy implementation; in the case of Ukraine, it is wartime imperatives, reconstruction needs and EU accession commitments that sometimes pull in different directions. However, as the following sections also lay out, many of the perils and opportunities of green geopolitics are inseparable. Every opportunity carries risk, and every risk contains potential openings. The challenge is not to eliminate trade-offs—which are unavoidable—but to govern them in ways that increase sovereignty, spread benefits more broadly, and align security imperatives with long-term climate and development goals. In this sense, navigating green geopolitics is not only about mitigating perils but also about creating the institutional conditions for the promise to materialize.

Geopolitical alignments and supply chain dependencies

Caught geographically and politically in a much wider contest between great powers, Ukraine has had its strategic options and sovereign choices significantly limited by external forces since its independence. Its economic dilemmas continue to be sharpened by its geopolitical vulnerability, with more limited access to Chinese capital and technology—in part as a result of its external security partnerships.

While these security partnerships are essential to Ukraine's sovereignty, they have become more precarious and transactional over the past year—particularly as it relates to the United States. This was exemplified by negotiations over the Ukraine–USA minerals deal, where security for Ukraine was conditioned by US interests in minerals and other natural resources. At the same time, diverging priorities among EU member states—particularly between short-term energy security and longer-term decarbonization—can complicate Ukraine's efforts to coordinate its own transition choices with those of its partners. These dynamics reflect a broader dilemma: Ukraine is expected to pursue ambitious reforms and supply critical materials to strengthen Western green energy security, even as some partners increasingly prioritize short-term military and energy needs over long-term sustainability commitments.

Political and security partnerships, in other words, have economic implications—including in the energy sector. This is being accentuated as supply chains have become

more globally politicized. While renewable sources of energy promise to reduce reliance on imported hydrocarbons, they also generate new forms of interdependency around grids, technologies, minerals and capital. For example, while renewables promise local generation, the equipment needed to deploy them is far from evenly distributed. For Ukraine, this dynamic is already visible: it relies heavily on imported solar panels, turbines and inverters, while much of its proposed contribution to energy transition in the wider West is focused on supplying raw or semi-processed materials.[141] This can amplify economic and even political asymmetries, although there remain opportunities for Ukraine to channel great power competition and supply dependencies into greater external investments that enhances Ukraine's domestic industrial capacity and capabilities.

These dynamics mirror a broader pattern visible across many middle-income and resource-rich countries. New green energy supply chains often reproduce older hierarchies of extraction, where environmental and social costs are borne domestically while value creation (through local processing, technology development and manufacturing) remains concentrated in advanced economies. Without deliberate green industrial policy and strong institutions, participation in these supply chains can leave countries supplying inputs while others capture the strategic gains. For Ukraine, this asymmetry is not only economic but also geopolitical: staying at the bottom of value chains risks hardening dependencies at a moment when the country seeks to expand its strategic autonomy.

Development and extractivism

The demand for transition-related critical minerals is an opportunity for mineral-rich countries such as Ukraine. However, reliance on exports of raw materials at the low end of the value chain can expose a country to the volatility of global markets. Resource exports are generally more vulnerable to price volatility than manufactured goods, this casts doubt on whether mineral wealth can deliver durable economic sovereignty.[142]

Comparative experience underscores both the perils and the opportunities of these dynamics. Where states have combined resource endowments with domestic processing requirements, coherent industrial policy and regional alliances (as in the examples of Indonesia's nickel, Chile's lithium or Southern Africa's cobalt and battery initiatives), they can capture greater value. Where such frameworks are absent, new dependencies simply replace old ones. Nonetheless, even when countries succeed in adding local value, these gains can remain fragile if they are not accompanied by sustained institutional capacity, reliable access to finance and to investments in the large-scale infrastructure needed to anchor higher-value activities. While such initiatives can generate openings and short-term economic growth in specific sectors, weak institutions and limited financing make it difficult to sustain or expand value creation over time.[143]

This underlines a central paradox. On the one hand, Ukraine has been given a role in Western mineral diversification strategies that are deemed essential for energy transition. However, without robust governance frameworks, binding local-content clauses and effective safeguards, Ukraine risks adopting a reconstruction model that is

[141] Dixi Group, 'From raw materials to finished products: Ukraine strives to integrate into global supply chains for critical minerals—URC 2025', 14 July 2025.

[142] Goldthau, A., Eicke, L. and Weko, S., 'The global energy transition and the Global South', eds A. Goldthau, M. F. Keating and C. Kuzemko, *The Geopolitics of the Global Energy Transition* (Springer: Cham, 2020); and van der Ploeg, F. and Poelhekke, S., 'Volatility and the natural resource curse', *Oxford Economic Papers*, vol. 61, no. 4 (Oct. 2009).

[143] Hendrix and Bazilian (note 46).

overly reliant on volatile commodity markets. This could expose it to boom-and-bust cycles and to bearing a disproportionate share of the environmental and social costs of its partners' energy transitions. Avoiding this trajectory requires mineral development to be aligned with a deliberate strategy for industrial upgrading and long-term resilience, rather than relying on exports of raw materials as a substitute for sustainable reconstruction.

Beyond economic dependence, the scramble for critical minerals also carries social and political risks, as intensified extraction reshapes local environments and governance dynamics. In such a highly geopolitical landscape, structural corruption risks within the extractives sector can weaken bargaining power and allow external actors to influence investment conditions or extract concessions, making governance a key strategic dimension.[144] More than that, new mining frontiers across the world have generated local resistance, land disputes and social fragmentation when communities are excluded from decision-making or bear disproportionate environmental costs for an energy transition from which they will not directly benefit.[145] Ukraine faces similar challenges, as civil society groups have urged that the country's 'green reconstruction' will need to avoid repeating past patterns of extractivism that marginalize local communities. Instead, they call for transparent consultation, environmental due diligence, and adherence to the principle of free, prior and informed consent in energy and mining projects.[146] As competition for critical minerals grows, ensuring public participation and social safeguards are essential to prevent green industrialization reproducing the governance failures of earlier extractive models.

Between competing priorities

For Ukraine there are particularly competing priorities at play in its energy transition. Many elements of energy transition and war-related societal or geopolitical resilience go together, as described in previous chapters. However, pressing military and humanitarian needs can also compete with longer-term commitments to sustainable development.[147] In a time of heightened threats, military security tends to receive more dedicated attention, priority and financing. This is even more the case in wartime Ukraine, where both political and financial resources are understandably more limited.

Other shorter-term economic expediencies may also weaken environmental and social safeguards. These contradictions are heightened by mismatched timescales: while climate goals require long-term consistency, short-term reactions to energy security shocks can also favour hydrocarbons or rapid fixes that undermine decarbonization strategies. However, higher environmental and sustainability standards are also important for Ukraine to be able to qualify for multilateral financing, which often has related environmental preconditions. Moreover, EU accession plans have bound Ukraine to ambitious climate and energy legislation, obliging it to pursue difficult reforms even under wartime conditions.

[144] Murphy, R., 'Accounting for the missing billions', ed. P. Reuter, *Draining Development? Controlling Flows of Illicit Funds from Developing Countries* (World Bank: Washington, DC, 2012); and Kar, D. and Schjelderup, G., *Financial Flows and Tax Havens: Combining to Limit the Lives of Billions of People* (Global Financial Integrity: Dec. 2015).

[145] Walter, M., Deniau, Y. and Herrera Vargas, V., 'The politics of "green" extraction frontiers: Mapping metals and mineral mining conflicts related to the energy transition in the Americas', *Critical Sociology*, vol. 51, nos 4–5 (July 2025); and Aritonang, M. and Shennum, K., *'Does Anyone Care?' The Human, Environmental, and Climate Toll of Indonesia's Nickel Industry* (Climate Rights International: Oct. 2025).

[146] 'Green reconstruction of Ukraine: Position of civil society', 5 May 2022.

[147] Krampe, F. et al., 'Armed conflict causes long-lasting environmental harms', *Environment and Security*, 11 Mar. 2025; and Weir, D., 'How does war damage the environment?', Conflict and Environment Observatory (CEOBS), 5 May 2025.

The issue of competing priorities is not unique to Ukraine. It is shared by the EU, where military security is potentially taking attention and financing away from climate action. Rising military expenditure risks reducing the funds available for climate finance while also reinforcing fossil fuel dependencies: armed forces remain among the largest institutional consumers of hydrocarbons, and military planners continue to rely on oil and natural gas for mobility, logistics and operations.[148]

However, the way in which these competing priorities play out reflects a wider set of international inequalities. OECD countries, with greater financial and technological capacity, are able to pursue accelerated deployment of renewables while cushioning their industries through subsidies and state support.[149] Others, including Ukraine, face tighter constraints: they must attract external finance, integrate into existing supply chains and comply with stringent conditions.

Taken together, these dynamics show that Ukraine's energy transition is neither insulated from geopolitics nor solely determined by it. Instead, its trajectory will depend on whether governance, investment and external partnerships can align in ways that transform structural constraints into strategic opportunities.

[148] Parkinson, S. and Cottrell, L., 'Estimating the military's global greenhouse gas emissions', Scientists for Global Responsibility (SGR) and Conflict and Environment Observatory (CEOBS), Mar. 2022.

[149] Matsumoto, Y. et al., *Government Support in the Solar and Wind Value Chains*, Organisation for Economic Co-operation and Development (OECD) Trade Policy Paper no. 288 (OECD: Paris, Jan. 2025).

6. Conclusions and recommendations

The green transition carries profound consequences for the international system as a whole, particularly in an emerging geopolitical order marked by more transactional and less cooperative economic relations. Green energy has the potential to reshape the distribution of power between states, alter patterns of dependence and interdependence, and reorder the political economy of energy and resources. At a global level, the transition offers opportunities to diversify energy sources, reduce the leverage of hydrocarbon exporters and mitigate the worst effects of climate change. At the same time, the process of transition also entails new dependencies (and interdependencies) on critical minerals and green technology supply chains, which are intensifying competition among great powers, with unevenly distributed social and environmental costs. In this sense, the transition embodies both perils and promise, the balance of which depends on how effectively states manage the political, economic and institutional trade-offs involved.

Ukraine's reconstruction is not just about rebuilding what was lost, but about building a resilient, modern energy system that underpins sovereignty and accelerates the green transition. To succeed, this effort must deliver value domestically while aligning with broader global and EU accession-related climate goals. In practical terms, this means building a resilient and flexible power system, retaining more of the value of strategic projects, preventing long-term commitments to fossil fuels and embedding social justice into transition designs. In doing so, Ukraine can illustrate how to navigate green geopolitics in a way that unlocks greater resilience, sovereignty and sustainable development—offering lessons for other middle powers and developing countries that face similar pressures.

Overall, the outcomes of the green transition will depend on how effectively states—especially those like Ukraine that are confronting acute security and climate pressures—govern the trade-offs between sovereignty, development and sustainability. By linking reconstruction to green industrialization, accountable governance and environmental integrity, Ukraine and its partners can turn the perils of green geopolitics into a roadmap for greater resilience and strategic opportunity.

Ensure local value creation and participation

As great powers compete globally for transition resources and seek to secure domestic supply chains for clean technologies, it is imperative for Ukraine and its partners to ensure that its participation in these value chains brings long-term and inclusive economic benefits to Ukraine and its people. This means conditioning that participation on support for domestic workforce development, technical assistance and industrial upgrading in order to make Ukraine more than a supplier of raw materials. Standardized technology-transfer and local-content requirements should be required in energy-related and extractive projects with international partners.

Beyond industrial upgrading, public participation and accountability must also be central. Free, prior and informed consent for new energy or mining projects along with independent monitoring and public disclosure can help prevent reconstruction from privileging security of supply for Ukraine's partners at the expense of domestic equity and environmental integrity in Ukraine.

Continue hydrocarbon phase-out and energy sector reform

Global net zero scenarios require demand for oil and natural gas to decline globally by around 20 per cent by 2030—too short a deadline to justify new large-scale fossil projects with long lead times.[150] In Ukraine, continued natural gas production and exploration remain components of energy security and export strategies. However, these also risk long-term commitment to fossil fuels. Ukraine should therefore tie any new fossil fuel investments to decommissioning schedules, emission limits and compatibility with the 2030 and 2050 targets in its National Energy and Climate Plan.

Importantly, hydrocarbon phase-out also entails measures on the demand side of the energy market, not only for Ukraine but also its partners in regional energy markets. This includes improving energy efficiency and expanding circular-economy solutions. Without coordinated demand-side action, production cuts on the supply side risk simply concentrating supply and rents in the hands of laggard petrostates, including Russia. A managed phase-out, grounded in joint planning and investment in alternatives, can instead enhance both energy security and climate integrity.[151]

Ukraine's hydrocarbon phase-out dovetails with its EU accession process and the alignment of its energy sector with EU rules. Each of these interconnected processes—decarbonization and EU accession—requires external financial support.[152] Particularly in a more constrained policy environment for aid, both Ukraine and its partners should ensure that this support is premised and conditional on wider good governance reforms that ensure that transition is equitable, transparent and socially as well as ecological sustainable.

Prioritize environmental goals alongside economic and security goals

Environmental considerations should not be sidelined in the name of economic expediency or short-term energy security. Reconciling climate, energy and security objectives is critical to ensuring long-term resilience. Investment decisions taken during wartime reconstruction will lock in development pathways for decades; aligning those decisions with sustainability standards and EU accession commitments will strengthen both Ukraine's and Europe's collective security. For larger-scale infrastructure, energy and extraction projects, investment in due diligence and environmental and social impact assessments (ESIAs) will have long-term payoffs. Strong governance, transparency and environmental integrity are not obstacles to energy transition but strategic assets that reduce future risks and build societal and ecological resilience.

Diversify geopolitical partners and embed resilience

Under current geopolitical conditions marked by economic unilateralism and turbulent—if not unstable—strategic alignments, middle powers and developing states should expand and diversify their partnerships, rather than narrow them. While Ukraine should remain firmly committed to the path of EU integration and accession, it and its partners should also maintain a global perspective—engaging with other markets, regions and multilateral forums to build a wider foundation for economic and ecological security. By diversifying its partnerships, Ukraine will reduce its vulnerability

[150] International Energy Agency (IEA), *Net Zero Roadmap: A Global Pathway to Keep the 1.5 °C Goal in Reach*, 2023 update (IEA: Paris: Nov. 2024).

[151] IAEA (note 150); and Bordoff, J. and O'Sullivan, M. L., 'Yes, we need to talk about cutting energy demand', *Foreign Policy*, 29 June 2022.

[152] Ukrainian Ministry of Finance, 'Ukraine Donor Platform: Government of Ukraine and international partners address support for the state budget and energy sector in 2026 and reforms', 24 Nov. 2025.

to supply disruptions and coercive external pressure, serving to enhance its strategic autonomy within a fragmented world order.

Finally, resilience is a key concept for Ukraine in the context of warfare, but it should also be a driving principle for meeting the challenges and uncertainties of green geopolitics more generally. As zero-sum competition persists and multilateral cooperation continues to weaken, economic and political uncertainties and disruptions will remain high. Security threats come from multiple sources; resilience must therefore be equally multidimensional—combining physical, economic, environmental and social dimensions. By embedding resilience into every stage of reconstruction, both within and outside the energy sector, Ukraine can transform the immediate imperatives of recovery into the foundations of a sustainable and sovereign future.

About the authors

Dr Jiayi Zhou is a senior researcher with the SIPRI Conflict, Peace and Security Programme, where she focuses on the intersection of great power competition and sustainable development. With a background studying the former Soviet Union, she has conducted research on and fieldwork in several East European and Central Asian countries, as well as other European countries and China. Zhou's recent publications include *Critical Minerals and Great Power Competition* (Oct. 2024, co-author).

Dr Bárbara Magalhães Teixeira is a researcher with the SIPRI Climate Change and Risk Programme, where her work explores how climate and environmental crises, conflict, and security intersect, with a focus on pathways to sustainable peace. Her recent publications include 'Room to grow and the right to say no', *Geopolitics* (2024).

STOCKHOLM INTERNATIONAL PEACE RESEARCH INSTITUTE
Signalistgatan 9
SE-169 72 Solna, Sweden
Telephone: +46 8 655 97 00
Email: sipri@sipri.org
Internet: www.sipri.org