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Transforming Ukraine into a European Energy Hub

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Foreword

Russia's unprovoked full-scale invasion of Ukraine has caused untold devastation. The country's civilian infrastructure has been targeted by Moscow, in direct violation of international law, to break Ukrainian defenses. Despite Russia's persistent attacks, Ukraine has demonstrated resolve to defend itself.

The Russian threat to Ukraine has accelerated its movement toward integration into the European and transatlantic political, economic, and security partnerships. It is in the interest of the United States and the European Union (EU) that Ukraine not only wins the war and recovers rapidly but also—with transatlantic support—embarks on a fast-track modernization to bring its political and economic systems in line with European standards. In these efforts, energy will play an important role.

There is growing understanding in the United States and Europe that Ukraine can be a critical pillar of Europe's energy security and green transition. The tremendous potential of a post-war Ukrainian energy sector described in this paper is also the best antidote to the dangers of returning to the pre-war energy relationship with Russia.

The United States and Europe must work together to make this happen. With the support of this transatlantic partnership, Ukraine can overcome a legacy of graft, political uncertainty, and opaque governance to create stable political and legal conditions to attract private sector investment and enable the transfer of new technologies. Governments' and international lending institutions' support will be critical for Ukraine's energy sector reconstruction and transformation, but private investment will also be vital for creating a prosperous, resilient, and self-sufficient energy system in Ukraine.

Merely restoring Ukraine's energy system to its prewar state will be insufficient to realize the country's potential; it must be upgraded to ensure long-term energy independence, reach decarbonization goals, and take on a broader role in European energy security as an energy exporter. Only through a transformation of its energy system can the country achieve these goals and capitalize on its resources. This is not only in Ukraine's interest but also in the interest of transatlantic energy security and global climate ambitions.

The Atlantic Council **Global Energy Center** develops and promotes pragmatic and nonpartisan policy solutions designed to advance global energy security, enhance economic opportunity, and accelerate pathways to net-zero emissions.

This paper identifies opportunities for the rebuilding of Ukraine's energy infrastructure for the transatlantic community to consider. These opportunities will enable Ukraine to support European energy security and decarbonization through partnerships between Ukrainians and other interested stakeholders, including the US government, the EU, and the international private sector. Transforming its energy system is important for Ukraine to build a prosperous and vibrant society through reliable export revenue streams and for the transatlantic alliance as a whole to neutralize the weaponization of energy and build a secure, net-zero economy. Moreover, reforming and integrating Ukraine's energy sector with Europe's will be crucial to the country's path to EU accession.

Laying the foundation for this vision ultimately falls on Ukraine itself, and the country must continue to make reforms, including tackling corruption and establishing strong standards and transparency for the rule of law. The primary aim of this issue brief is to demonstrate that, with regard to Europe's energy security and climate challenges, Ukraine is not part of the problem, but part of the solution.

Introduction

Ukrainians have withstood relentless Russian attacks on their country's civilian energy infrastructure. Over 50 percent of Ukraine's power grid has been destroyed by those attacks.¹ In monetary terms alone, the energy infrastructure damage in early 2023 was estimated to stand at more than \$11 billion.² These costs increase with each day of the war.

To ensure Ukraine's future security and economic and political viability, the reconstruction and transformation of the country's severely damaged energy system is a necessity. The World Bank estimated in March 2023 that this colossal undertaking could cost as much as \$411 billion.³

Uncertainty over how the war will develop complicates plans for rebuilding the energy system. Nevertheless, much of this reconstruction will need to begin even before peace is achieved, as international partners are already assisting Ukraine in repairing its energy system to sustain

its defense against Russia's invasion and maintain basic services.

Rebuilding and modernizing Ukraine's energy infrastructure must go beyond providing essential energy needs. Efforts must also springboard the economy onto a path toward greater energy autonomy. Shifting the financial model of the energy sector will be a crucial step toward this goal. With the support of allies and private investors, Ukraine must act to leverage existing energy infrastructure and expertise to capitalize on its potential as an energy producer, exporter, and service provider.

In the longer term, Ukraine has the potential to be an energy leader in Europe, assisting the continent in diversifying its energy supply and supporting its climate efforts. While Ukraine still relies on coal for 30 percent of its energy mix,⁴ a quarter of its energy comes from nuclear power—a figure that could rise significantly if the now-occupied Zaporizhzhia Nuclear Power Plant, Europe's largest, is brought back online and fully under Ukrainian control.

In addition to having expertise in nuclear energy to share with its European neighbors, Ukraine is also developing markets and know-how in wind, solar, and hydropower. These growing industries can lay the foundation for clean energy exports within a common European framework for decades to come. Ukraine is already sending electrons to Moldova and its EU neighbors. It could expand grid interconnections and fully integrate Ukraine's power market with the rest of Europe's. Ukraine's human capital, vast energy resources, resilience and innovation, and opportunity to build a new energy system from the ground up in its war-torn regions positions the country as a sandbox for new technologies that can help Europe and the rest of the world transition to an affordable, energy-secure, and net-zero economy.

The reconstruction of Ukraine's energy system will occur in two major phases: during the war and after. This issue brief will outline immediate energy needs and peacetime priorities for transforming the country's energy infrastructure, as well as the financing mechanisms required to achieve this massive undertaking.

1 Lisa Schlein, "UN: Half of Ukraine's Energy Infrastructure Destroyed by Russian Attacks," Voice of America, December 13, 2022, <https://www.voanews.com/a/un-half-of-ukraine-energy-infrastructure-destroyed-by-russian-attacks/6874897.html>.

2 Burc Eruygur, "Cost of War Damage in Ukraine Near \$138B: Official," Anadolu Agency, January 25, 2023, <https://www.aa.com.tr/en/politics/cost-of-war-damage-in-ukraine-near-138b-official/2797106>.

3 "Updated Ukraine Recovery and Reconstruction Needs Assessment," press release, World Bank, March 23, 2023, <https://www.worldbank.org/en/news/press-release/2023/03/23/updated-ukraine-recovery-and-reconstruction-needs-assessment>.

4 *Ukraine Energy Profile*, International Energy Agency, April 2020, <https://www.iea.org/reports/ukraine-energy-profile>.



A view shows the Zaporizhzhia Nuclear Power Plant before the arrival of the International Atomic Energy Agency mission in the course of Russia-Ukraine conflict, June 15, 2023. REUTERS/Alexander Ermochenko.

Maintaining Ukraine's defenses requires energy reconstruction and development efforts to begin immediately, but they must also incorporate a strategy for the future. Efforts must assure the country's long-term energy security and contributions to global decarbonization. Achieving both will require shifting risk and management mechanisms to encourage investments in wartime. The Ukrainian government, local civil society, international public sector donors, and private sector investors will have to coordinate carefully on the sequence and scale of rebuilding when deploying various technologies and infrastructure.

Ukraine has already developed an initial road map for the reconstruction work, an important starting point that will be adjusted based on the war's developments and external stakeholder input. Ultimately, the success of transforming Ukraine's energy sector will be tied to progress on anti-corruption efforts and sector reforms, upon which continued financial and capacity support from allies will depend. But first, Ukraine's energy system must hold out against Russian attack.

Immediate energy security needs

Prevailing against Russia's energy war is essential for ensuring that Ukraine can defend itself and push the armed conflict toward victory. Russia's attacks on Ukraine's energy system, consisting of hundreds of missiles fired at civilian infrastructure since October 2022, have continued into the spring. These attacks include the destruction of the Kakhovka Dam, which caused massive ecological and societal devastation and loss of power in the region. Ukraine's electricity interconnections with Europe have also been affected by the assault on its energy system. Moreover, the illegal occupation of cities with significant energy generation capacity, most prominently Zaporizhzhia, is throttling electricity trade with Europe.

Repairing the damage to fortify Ukraine and restore the export of electrons will be crucial for the war effort. This work will require logistical and technical support, as well as financing to bring projects to fruition. Governments and multilateral financial institutions will need to bear the lion's share of the responsibility and risk for financing Ukraine's urgent energy needs. Additionally, Ukraine

needs assistance in compensating the private sector for supplying critical energy services, which currently lack financing. Finding the right level of burden-sharing between the private and public sectors will be important for coalescing finance and expertise for this task.

Most immediately, Ukraine needs equipment critical to energy infrastructure. This includes autotransformers, switches, cables, circuit breakers, surge arresters, disconnectors, vehicles, and other devices as well as diesel generators, batteries, and modular power plants.

The acquisition of autotransformers is of particular importance to repairing Ukraine's grid, given how difficult they are to obtain. The US Agency for International Development has already engaged in direct procurement to purchase and transport compatible transformers and generators to Ukrainians.⁵ The Baltic states, as they modernize their post-Soviet grid in anticipation of synchronizing with the rest of Europe's, have also donated large numbers of autotransformers.⁶ Formidable obstacles, however, stand in the way of obtaining an adequate number of these devices, including a limited supply of the type of autotransformer that Ukraine needs, long lead times for manufacturing, and difficulties in transporting the massive pieces of machinery, which can weigh hundreds of tons.⁷

Additional autotransformers for Ukraine could come from the Baltics and other former Soviet-occupied republics, which use the type of equipment Ukraine needs. Freeing these autotransformers for Ukraine's use would require the United States and the EU to provide increased support to suppliers' desynchronization and modernization efforts—already a subject of EU funding and US technical support in the Baltic states. Transporting the machinery through spatially constrained corridors would also require US and European assistance. This would be a formidable task, but one with the added benefit of enhancing electrification to degrade Russian gas export markets and free up additional fuel exports from these states.

Ultimately, there is a limited supply of high-voltage transformers and it will be up to the private sector to produce custom-made equipment. Delivering the right parts and equipment as quickly as possible to locations

remains a challenge for donors. Forging direct contact between mayors and local leadership in Ukraine and international donors, including nearby former Soviet-occupied states, could streamline the logistical challenges and plug informational gaps for the unique needs across Ukrainian districts.

In addition to transformers, Ukraine must fortify existing infrastructure, including through the de-mining of energy production assets. Furthermore, Ukraine must decentralize its power system, which can be done rapidly through mobile generators and batteries. These immediate measures will help the country keep the lights on and maintain the fight against Russia. Decentralizing Ukraine's energy system will improve grid security both during the war and long afterward.

Another urgent energy infrastructure priority is the safety of the Zaporizhzhia Nuclear Power Plant. Russia's attack on the Kakhovka Dam has exacerbated safety concerns at the plant, which relies on the reservoir for cooling. While alternative water sources can be made available to serve this function, the danger of Russian sabotage increases every day. The international community should prioritize international action to ensure the plant's safe operation.

Finally, in preparation for the upcoming winter, Ukraine, with the support of the international community, should take several other immediate actions. Supporters should provide the country with energy-efficiency products, such as insulation, to ensure its people can withstand the winter. Additional resilience centers, which provide crucial temporary support for communities during blackouts, need to be built.

In the near term, Ukraine is also likely to need subsidized natural gas imports to meet demand, having imported nearly 1 billion cubic meters (bcm) over the past winter. To bolster its energy supply, Ukraine should secure gas for winter heating by expanding its import infrastructure with two-way interconnectors that link the country with nearby liquefied natural gas importers Poland and Croatia. In the longer term, Naftogaz aims to increase production by 1 bcm to cover domestic demand and make the country a net exporter for the first time in its history, meaning that two-way infrastructure can have a dual purpose in

5 "USAID Announces Additional \$125 Million in Urgent Energy Support for Ukraine," press release, U.S. Agency for International Development, January 18, 2023, <https://www.usaid.gov/news-information/press-releases/jan-18-2023-usaid-announces-additional-125-million-urgent-energy-support-ukraine>.

6 "Lithuania Delivers Autotransformer to Ukraine," *Transformers Magazine*, March 2, 2023, <https://transformers-magazine.com/tm-news/lithuania-delivers-autotransformer-to-ukraine>.

7 Suriya Evans-Pritchard Jayanti, "Ukraine Struggles to Repair Power Grid as Russian Airstrikes Continue," Atlantic Council, January 13, 2023, <https://www.atlanticcouncil.org/blogs/ukrainealert/ukraine-struggles-to-repair-power-grid-as-russian-airstrikes-continue>.



The destroyed Nova Kakhovka dam, Beryslav town and Dnipro riverbank are seen from the town of Nova Kakhovka in Kherson region, July 5, 2023. REUTERS/Alexander Ermochenko.

securing Ukraine's energy system today and the rest of Europe's tomorrow.

Laying the governance groundwork

Ukraine's immediate needs require repairing the damage wrought by Russia's attacks to hold the country over through the summer offensive and ensuing winter bombardments. However, these efforts must coincide with political and market reforms aimed at improving the governance of Ukraine's energy sector and combating the historic scourges of corruption and favoritism that have hindered the country from developing its energy system to its full potential. Significant progress was achieved before the full-scale invasion in addressing corruption, particularly on the local level, but these reforms and transparency measures stalled in many areas due to the war. Ukraine must resume these steps to ensure the country's integration into a diversified Euro-Atlantic energy system.

The war also throttled reforms aimed at creating a liberal market economy. Kyiv nationalized much of its energy industry to maintain control of this vital sector as the

country's economy transitioned to a wartime footing. This trend was not unique to Ukraine, as multiple European countries had to nationalize big energy providers to ensure security of supply amid the energy crisis. As the war comes to a close, however, Ukraine must liberalize its energy sector again to attract foreign investment.

This presents an inflection point in Ukraine's path toward further European integration. Liberalization should proceed according to the highest standards for corporate governance and be done in full compliance with the EU's established body of law, the *acquis communautaire*, adherence to which is a prerequisite for EU accession. Of particular note is the Third Energy Package, which requires robust competition within the energy value chain and separated ownership between its different steps, including production, transmission, and distribution. Ukraine has made substantial progress since joining the Energy Community in 2010—an EU association mechanism that tied it to the adoption of the energy *acquis*—and this momentum must be restarted after the war. By liberalizing the sector with an eye toward creating a competitive market with low barriers to entry, Ukraine can reduce the

power of oligarchic interests and encourage investment in the sector. Liberalization is therefore vital to enlist private capital to finance Ukraine's reconstruction.

Implementing the *acquis* is essential to Ukraine's ambitions of becoming a member state of the EU. The success of that endeavor will require substantial progress on transparency measures and creating fair competition in the market. It will also require Ukraine's adherence to the objectives of the European Green Deal, including a formal, binding, and credible pathway from Kyiv to achieve net-zero emissions by 2050. The law "On Amendments to Certain Laws of Ukraine Regarding the Restoration and Green Transformation of the Energy System of Ukraine," adopted by the Parliament in May 2022, is designed to support renewable energy deployment and certify the origin of green electricity. The law is a good step toward integrating the country into the EU power market and reducing its emissions in accordance with the objectives of the legally binding European Climate Law, which Ukraine must adhere to as an EU candidate state.⁸

In addition, the European Union must signal to Ukraine that should it meet EU membership criteria, its path to accession is a credible one. This signal is needed to sufficiently incentivize Kyiv to stay the course on the most difficult market reforms. Ukraine becoming a full-fledged member of the European single market goes hand in hand with rooting out the remaining legacy of Soviet-era corruption and bringing the country fully into the Euro-Atlantic fold. Moreover, the large-scale restructuring and transforming of the country's energy system to achieve its full potential to support European energy security cannot happen without membership. The United States, European Union, United Kingdom, and other interested partners can ensure high-level official capacity committed to these aims while sending an unmistakable message that Ukraine presents a substantial investment opportunity by appointing special envoys for Ukraine's green reconstruction. Such envoys can be point-people for the respective national private sectors to get involved with the reconstruction and integrate Ukraine more firmly

into the European and transatlantic economic and security arrangements.

Postwar opportunities

Building on its resources, Ukraine could become a net energy exporter, helping diversify Europe's economy away from dependence on Russian energy. Ukraine would then present Europe with excellent opportunities if political and security challenges can be adequately addressed. The development of Ukrainian energy resources could help Europe achieve energy security with adequate investment. These resources include its natural gas supply and transport infrastructure, mineral reserves, and renewable and advanced energy industries. This is not only in Ukraine's interest but also all of Europe's.

Hydrocarbon Supply and Infrastructure

Ukraine's gas system and financial model must remake itself to eliminate the country's dependency on Russian transit. Before the war, transit fees for Russian gas flowing through Ukrainian pipelines to the EU were an important contributor to Ukraine's federal budget, earning \$1.2 billion a year before the invasion. The expiration of the current transit agreement at the end of 2024 adds uncertainty to the future of Russian gas transit in Ukraine. The war and Europe's ongoing energy diversification are rapidly reducing demand for Russian gas, making an extension of this agreement unlikely. Nevertheless, limited flows may continue beyond 2024 absent a formal agreement. Russian gas volumes, however, have been in terminal decline, from 136 billion cubic meters per annum (bcm) in 2005 to 42 in 2020. Ukraine needs new revenue sources to replace Russian transit fees.⁹

Expanding Ukraine's native gas production could rapidly strengthen Europe's energy security while providing Ukraine with a new income stream. Ukraine's domestic gas industry produced nearly 20 bcm in 2021 and production has remained steady despite the war.¹⁰ Ukraine's gas reserves could supply even larger volumes. The country has Europe's third-largest known natural gas reserves after only Russia and Norway, at 1.09 trillion cubic

8 Energy Community Secretariat, "Analysis of the Draft Law of Ukraine 'On Amendments to Certain Laws of Ukraine Regarding the Restoration and Green Transformation of the Energy System of Ukraine,'" Ukraine Energy Market Observatory, June 2023, <https://www.energy-community.org/dam/jcr:f58f9b75-dc4a-4ee6-b34e-b1d4cc367173/Note08.pdf>.

9 Ben Cahill and Leslie Palti-Guzman, "The Roll of Gas in Ukraine's Energy Future," Center for Strategic & International Studies, January 13, 2023, <https://www.csis.org/analysis/role-gas-ukraines-energy-future>.

10 "Factbox: Ukraine's energy options limited in event of Russian gas disruption," Reuters, February 24, 2023, <https://www.reuters.com/business/energy/ukraines-energy-options-limited-event-russian-gas-disruption-2022-02-24/>; Andrian Prokip, "Ukraine's Gas Market after the War," Wilson Center, March 8, 2023, <https://www.wilsoncenter.org/blog-post/ukraines-gas-market-after-war>.

meters.¹¹ A 2012 report by IHS CERA estimated that, with the right investments, Ukraine's yearly production could reach 70 bcm by the mid-2030s.¹² Naftogaz is already discussing with Halliburton, Chevron, and ExxonMobil the development of natural gas reserves in the country. Measures to reduce war-related financial risks and reduce physical risks, including from unexploded mines and cluster munitions, will be critical to leverage private sector involvement.

Gas production is not the only way Ukraine can earn new income streams without Russian transit. With 31 bcm of gas storage—equivalent to one-third of the EU's current capacity—Ukraine could sell spare capacity to neighboring countries, in turn helping Europe expand its storage to insure against future supply disruptions.¹³ Ukraine's cavernous gas storage capacity, largely in the more secure west of the country and of which 10 bcm is available for use, could provide a significant impact on energy security in the region.¹⁴ To mitigate risk brought on by the war, Ukraine needs insurance mechanisms to provide foreign buyers with assurances around the security of its storage arrangements.

Becoming a central player in Europe's gas system also presents Ukraine with an opportunity to support Europe's long-term decarbonization efforts. By investing in scope 1 and 2 decarbonization of the country's gas production, Ukraine could minimize the emissions of its gas to Europe, replacing gas from Russia's opaque and emissions-intensive supply chain. Leveraging expertise from the US and European private sector to make this happen will be crucial for the continent's energy security and climate objectives.

Supply Chain and Renewable Energy Potential

As demand for minerals needed for clean energy technologies intensifies, Ukraine could play a significant role in an emerging net-zero economy. Ukraine's location

adjacent to one of the world's largest demand centers for clean technologies, and increasing integration into the European single market offer it an unparalleled opportunity to prosper from its natural resources while supporting Europe's net-zero targets.

Possessing 117 of the world's 120 most commonly utilized minerals, Ukraine could become a significant supplier of metals required for clean energy technologies.¹⁵ The country is the globe's sixth-largest producer of graphite—a key battery metal whose supply chain is currently dominated by China—and is aiming to dramatically ramp up extraction of its reserves, which total 13.7 million tons. The country is also one of the world's leading sources of non-Russian- and non-Chinese-supplied titanium, another critical mineral that is particularly needed for the defense industry.¹⁶

Ukraine is home to reserves of other clean energy technology metals, including copper, lithium, and cobalt, which could bolster Europe's clean energy supply chains if the requisite investments are made to extract the metals. Ukraine's government is committed to boosting production of these key minerals by attracting foreign direct investment through auctioning concessions.¹⁷ Support for these efforts by extending loan guarantees or subsidies along the lines of the US Inflation Reduction Act or EU Net-Zero Industry Act could help with exploring the potential for a Ukrainian critical raw materials supply for US and European clean energy industries.

Ukraine's eagerness to expand its critical raw materials industry could be a boon to the European Union's ambitions to onshore 10 percent of the extraction needed to fulfill EU demand for clean energy technologies. EU-Ukraine cooperation on minerals is linked to the 2021 strategic partnership on raw materials, which focuses on regulatory alignment with regard to environmental and social policies related to the mining sector, supply chain integration between the EU and Ukraine in the mineral

11 Anatoliy Amelin, Andrian Prokip, and Andreas Umland, "The Forgotten Potential of Ukraine's Energy Reserves," *Harvard International Review*, October 10, 2020, <https://hir.harvard.edu/ukraine-energy-reserves/>.

12 "Ukraine Gas Production Has Potential," Hart Energy, January 19, 2012, <https://www.hartenergy.com/news/ukraine-gas-production-has-potential-81846>.

13 John Kemp, "Column: Europe only has space for a small gas refill in 2023," Reuters, April 16, 2023, [https://www.reuters.com/business/energy/europe-only-has-space-small-gas-refill-2023-kemp-2023-04-14/#:~:text=The%20European%20Union%20and%20the,Gas%20Infrastructure%20Europe%20\(GIE\)](https://www.reuters.com/business/energy/europe-only-has-space-small-gas-refill-2023-kemp-2023-04-14/#:~:text=The%20European%20Union%20and%20the,Gas%20Infrastructure%20Europe%20(GIE)).

14 Frédéric Simon, "Ukraine Offers 10 BCM of Gas Storage to Europe for Next Winter," Euractiv, April 5, 2023, <https://www.euractiv.com/section/energy-environment/news/ukraine-offers-10-bcm-of-gas-storage-to-europe-for-next-winter/>.

15 Anthony Faiola and Dalton Bennett, "In the Ukraine War, a Battle for the Nation's Mineral and Energy Wealth," *Washington Post*, August 10, 2022, <https://www.washingtonpost.com/world/2022/08/10/ukraine-russia-energy-mineral-wealth/>.

16 Anthony Barich, "Metals and the Invasion: Ukraine Aims for Critical Minerals After the War," S&P Global Market Intelligence, February 21, 2023, <https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/metals-and-the-invasion-ukraine-aims-for-critical-minerals-after-the-war-74205684>; David Brennan, "The Battle for Ukraine's Titanium," *Newsweek*, January 28, 2023, <https://www.newsweek.com/battle-ukraines-titanium-1777106>.

17 Barich, "Metals and the Invasion."

and battery sectors, and research and development cooperation under the Horizon Europe program.¹⁸

Explicitly designating Ukraine, an associated state, as a qualifying European state for the sake of domestic critical raw materials benchmarks could entice the private investment needed to help meet and even exceed the objectives of EU legislation. In addition, investments to colocate further steps of the supply chain—from processing and refining to end-stage component manufacturing—could also meet EU supply chain targets while maximizing cost savings to turbocharge Europe’s energy transition. While the minerals sector is known for its long lead times, investments taking place now in Ukraine will be critical for ensuring sufficient supplies in Europe for clean energy materials. Given the potential for resistance to domestic mining as seen in EU countries, the buy-in of local communities will be key to enabling the minerals industry expansion.

A strong local supply chain would also help enable Ukraine to achieve its own significant ambitions for renewable energy. Within the Eastern European region, Ukraine added the most wind and solar power between 2017 and 2021; and in 2021, the Ukrainian government set a goal of sourcing a quarter of its power from renewables by 2035. Ukraine’s substantial progress toward achieving that goal, however, suffered a severe setback with Russia’s invasion, which has taken 30 percent of its solar power and 90 percent of its wind power out of operation.¹⁹ Restarting or repairing destroyed or idled wind and solar generators will help augment Ukraine’s carbon-free energy exports to the rest of Europe along its grid interconnections with Poland, Romania, and other large centers of energy demand. Ukraine is already making progress on this objective during the war, with the massive new Tyligulska wind farm brought online in the Mykolaiv region. It plans to add dozens of additional turbines to bolster resilience and provide needed energy generation in the region.

Investments are needed to increase the supply of renewable generation above where it was before the war, and financial incentives are already in place. The March 2022 emergency synchronization of Ukraine’s grid with the rest of Europe’s added large new export markets to

stimulate investment. Since then, Ukraine has also worked with the European Network of Transmission System Operators to steadily increase transfer capacities. Adding more infrastructure to connect Ukraine with its neighbors to the west will add to the interest of investors in building more generation capacity in the country.

Energy-Efficiency Technologies

The immediate aftermath of the war will also provide an opportunity for Ukraine to pioneer energy-efficiency technologies. As Ukraine rebuilds homes and buildings, ensuring that construction proceeds with energy efficiency—and therefore energy security—at front of mind can better prepare the country for future contingencies while also maximizing its ability to export energy and generate revenue.

Leveraging transatlantic expertise in building performance—from the United States’ Energy Star program to Brussels’ passive house standard—can help Ukraine optimize its energy use. Expanding existing financial mechanisms such as the prewar Ukraine Energy Efficiency Fund from the World Bank can help ensure that these principles guide the rebuild of Ukraine’s non-energy infrastructure.²⁰ In addition, Ukraine needs to incorporate greater energy efficiency into its district heating system—one of the largest in the world. The use of biomass and large-scale heat pumps could reduce the system’s reliance on gas and improve the resiliency of the country’s heat sector.

Grid Electrification and Advanced Technologies

A grid that can handle the demands of electrification will be crucial for weaning Ukraine off Russian hydrocarbons. Enabling growth in electrification will entail expanding the capacity of Ukraine’s grid and enhancing its responsiveness to new patterns of electricity demand. The technical advice of the United States’ National Laboratories can play a significant role in ensuring that Ukraine is able to build the grid of the future.

To electrify the grid with clean energy, Ukraine’s support for new technologies, including advanced nuclear and hydrogen, can help the country adapt to future energy

18 “EU and Ukraine Kick-Start Strategic Partnership on Raw Materials,” press release, European Commission, July 13, 2021, https://single-market-economy.ec.europa.eu/news/eu-and-ukraine-kick-start-strategic-partnership-raw-materials-2021-07-13_en.

19 Erin X. Wong, “Russia’s Invasion Knocked Out Almost All of Ukraine’s Wind Power,” Bloomberg, September 14, 2022, <https://www.bloomberg.com/news/articles/2022-09-14/russia-s-invasion-knocked-out-almost-all-of-ukraine-s-wind-power?sref=a9fBmPFG#xj4y7vzkg>.

20 “An Energy-Efficiency Program in Ukraine Heats Up,” International Finance Corporation, June 29, 2020, https://www.ifc.org/wps/wcm/connect/news_ext_content/ifc_external_corporate_site/news+and+events/news/impact-stories/ukraine-energy-efficiency.

demands over a longer timescale. The Ukrainian government, like many of its neighbors in Central and Eastern Europe, has embraced advanced nuclear technologies in the form of small modular reactors (SMRs). In April 2023, Ukraine's state nuclear company, Energoatom, signed a cooperation agreement with US-based Holtec to build as many as twenty SMRs, targeting operation by early 2029.²¹

For Ukraine, SMRs feature a number of advantages over the conventional nuclear power plants the country is accustomed to. One is their dispatchability (i.e., operators can stop and restart them in response to demand). Their practical size enables their transport to areas of higher demand, where they can help with grid management. Additionally, SMRs can generate heat for industry. Therefore, placing SMRs at sites occupied by wartime mobile generators and coal plants can help smooth the transition from a wartime and fossil-based energy system to a cleaner and more resilient one long into the future.

Given this opportunity to grow its nuclear energy industry, Ukraine, in partnership with Western allies, can play a prominent role in helping Europe diversify from Russian nuclear supply chain dependencies for both conventional and advanced reactors. Ultimately, SMRs, in combination with a build-out of Ukraine's vast wind and solar potential, could produce an excess of electricity for transport across the country's interconnections to the west along its synchronized grid with the rest of Europe's.

These surplus electrons could also allow Ukraine to build a hydrogen industry by supporting its clean production and its export to the rest of Europe. Hydrogen is set to become a critical part of the European energy mix, and Ukraine could have a unique opportunity to use renewable electricity or nuclear power to make zero-carbon hydrogen that can support Europe's energy security.

The growth of a hydrogen industry will require strategic siting for production and infrastructure to transport the fuel. Ukraine's extensive gas infrastructure can eventually be retooled for hydrogen, as its gas exports to Europe plateau. As offtakers of the fuel, Ukraine's heavy industry could forge hydrogen hubs to reduce the carbon intensity of steelmaking and the production of other industrial materials.

Moreover, Ukraine's gas transport infrastructure can help the EU meet its ambitious transportation goals through biogas and e-fuels production. Its agricultural industry and energy infrastructure put Ukraine in an advantageous position for supporting Europe's transition from fossil gas to cleaner alternatives.

Financing Ukraine's future as an energy hub

Ukraine will need significant public and private investment to fulfill its potential as a European energy hub, and a favorable political and regulatory environment can only go so far in cajoling foreign investment. Barring a Ukrainian routing of Russian forces, any peace with Vladimir Putin's Russia is likely to be an uneasy one, with the threat of renewed invasion persistent. The future of security guarantees to Ukraine—whether through NATO membership or other arrangements—is beyond the scope of this issue brief, although it will undoubtedly affect the investment climate for Ukraine's energy system. Ukraine's ultimate objective to join NATO would certainly have a positive impact on the investment climate in the country.

Making the country an attractive prospect for private investment requires solutions to negate the investment risk stemming from a possible renewal of hostilities. Regardless of the security arrangements that appear after the war, Washington, Brussels, and other allied capitals can coordinate on providing war-related risk insurance, which would cover losses only attributable to renewed invasion. Stakeholders in the international development finance sector should endeavor to reduce the war-related risks of investing in Ukraine as much as possible. This should include being circumspect in their provision of risk insurance to not overincentivize ill-conceived and speculative investments that would encourage bad behavior on the part of the energy sector in Ukraine.

Beyond addressing the risk of reinvasion, innovative financing mechanisms will be needed to overcome the unique challenges facing the rebuilding of Ukraine's energy system. It is unlikely that the colossal price tag will be footed solely by international governments, multilateral organizations, or philanthropic institutions. Ultimately, Ukraine will need a mix of public and private capital and blended financing offerings that allow for investors' varying tolerance for risk associated with different parts of Ukraine's energy system.

21 "Mass Deployment of Holtec SMRs in Ukraine Is Part of Accord's Aims," World Nuclear News, April 24, 2023, <https://www.world-nuclear-news.org/Articles/Accord-sees-mass-deployment-of-Holtec-SMRs-in-Ukra>.

Given the magnitude of investment required and Ukraine's history of endemic corruption, the highest level of transparency and oversight will be needed. Ukraine is already creating transparency and independent verification mechanisms, including the utilization of digital services to streamline oversight and build trust with the financial community. These changes must penetrate every layer of governance at scale to forge lasting changes. This overhaul requires a common approach by the various agencies and governments that would provision aid. Moreover, the prioritization of sectors that can contribute most immediately and durably to gaining Ukraine new streams of revenue—including those with long-term business potential in line with Europe's energy security and climate ambitions—can help provide effective oversight of the money sent to Ukraine.

Promising finance developments took place at the London Ukraine Recovery Conference in June 2023. The United States, European Union, United Kingdom, and others announced billions in additional aid for Ukraine's postwar reconstruction, much of which—though far from all—will go toward the energy sector. Four hundred private companies pledged to engage in the reconstruction efforts, and Ukrainian President Volodymyr Zelenskyy provided an update on launching Ukraine's reconstruction fund. The biggest takeaway was the urgency around investing in Ukraine as soon as possible and the risks around delaying reconstruction until peace is achieved. The success of the conference will be measured in the tangible private-public project announcements that take place this year.

Undoubtedly, the war and its uneasy aftermath will make attracting foreign investment a difficult proposition, but the abundant opportunities inherent in Ukraine's energy system can compensate for the risks if the right policy frameworks are put in place.

Conclusion

The work to reconstruct Ukraine's energy system must start now. The damage sustained by Russia's assault must be repaired swiftly to protect Ukrainians against a harsh winter and allow the country to continue to repel an invasion of its territory.

The immediate needs are substantial for Ukraine and must take priority before an ambitious yet vital restructuring of its energy system takes place. At the same time, short-

term reconstruction efforts should, whenever possible, be done in a way that secures Ukraine and its energy system for the long term. In other words, rebuilding must not only keep the lights on but also lay the foundation for a future energy system that is autonomous from malign Russian influence. This approach is essential for ensuring the vitality of Ukrainian society after the war.

A transformed energy system is not only in Ukraine's interest but all of Europe's. It has the potential to enable Ukraine's transition into an energy exporter to the rest of the continent. An energy system overhaul can also assist in the ongoing reorientation of Europe's energy system away from fossil fuels and toward a more secure and sustainable pathway.

Reconstruction efforts will be implemented under two parallel axes within Ukraine's double war: one against Russia and the other against corruption. Completing these reforms cannot wait until the war has ended. The measures present an opportunity to put Ukraine in line with the *acquis communautaire* of the EU to allow it the chance of developing a competitive market economy according to European standards and lay the groundwork for future EU accession.

These reforms are vital for Ukraine's reconstruction of its energy sector, while the greening of the sector is equally as critical for a potential future as an EU member state. To make success more likely, European policymakers should make clear that Ukraine has a credible path toward EU membership should it be able to achieve the objectives set before it. Ukraine's transatlantic partners should also put in place officials dedicated to helping Ukraine rebuild its energy infrastructure in a transparent and sustainable way, including special envoys for the country's green reconstruction.

Ukraine's green transformation is essential both for its adherence to the *acquis* and for its ambitions to make the country an alternative supplier of clean energy for Europe. Ukraine's integration into the European energy market has already begun, with the synchronization of the country's grid with the rest of Europe's in March 2022. By strengthening Ukraine's energy system as it is rebuilt during and after the war, Europe and its partners are investing in a more secure, cleaner energy system for the future.

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