

## Ukraine distributed energy systems

Nuclear power plays a significant role. The Zaporizhzhia plant in southwest Ukraine, Europe's largest nuclear power plant, was occupied by Russian troops and hasn't supplied electricity since September 2022. However, a further three nuclear power plants with seven reactors between them remain operational in the east and south and continue to supply Ukraine with electricity. However, Russia's repeated attacks on the distribution grid lead to hours-long power cuts, including in the capital city of Kyiv. "That's why Ukraine should develop a distributed power supply system," Doronina says. A centralised system is easier to attack, whereas independent systems are more resistant to war and crisis.

Renewable power plants that harness solar or wind energy are particularly suitable for distributed infrastructure and can be installed much more quickly than centralized conventional plants. "However, municipalities must be able to produce enough renewable energy locally to meet their power needs," Doronina says.

The researchers created high-resolution maps of Ukraine's various regions, showing the areas in which power generation from solar and wind energy is most favourable. The team took into account several criteria such as altitude and topography, population density as well as distance to settlements and to power grids. "We meticulously considered protected areas and state agricultural land, ensuring full compliance with the requirements and limitations of Ukrainian legislation," Doronina says.

Until now, Ukraine's energy infrastructure has been monopolised by one or two oligarchs. "They had control over the national energy market and worked together with Russia. It was also a breeding ground for corruption," explains Vasyl Doronin, head of the NGO Ukrainian Hydrogen Association and coauthor of the study.

Doronina, I, Arlt, M-L, Galleguillos Torres, M, Doronin, V, Gr?t-Regamey, A, Schmidt, T, Egli, F. Why renewables should be at the center of rebuilding the Ukrainian electricity system. Joule, 18 September 2024. DOI: external page 10.1016/j.joule.2024.08.014

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Distributed renewable power sources like wind turbines could make Ukraine's grid more resilient during the ongoing war.

Earlier in April, the U.S. ambassador to Kyiv was at Ukraine's Khmelnytskyi nuclear power plant, celebrating the first concrete poured for the first of two U.S.-designed AP1000 nuclear reactors to be built at the site "s



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just the start of Ukraine's state-owned nuclear power firm's investment plans. In June, Energoatom says it will start building two further VVER reactors at Khmelnytskyi, which will double the site's complement of Russian-designed equipment.

Energoatom's costly plans for more centralized power equipment have sparked alarm among independent energy experts in Ukraine. What Ukraine needs and can afford during wartime, they argue, is a large number of smaller power plants--generators that are relatively cheap, quick to build, less reliant on the national transmission grid, and harder for Russian missiles and drones to destroy.

Local utilities and international donors have focused on small-to-medium-size gas-fired turbine and engine generators, and the United States Agency for International Development (USAID) says more such assistance will come thanks to the US \$61 billion aid package just signed by President Biden. Oleksandr Kharchenko, who runs the Kyiv-based Energy Industry Research Center, says gas-fired generators are quick to install and plug into Ukraine's domestic natural gas and robust pipeline network. "You need something which can switch on and work when you need it," he says.

But others are also pushing renewable energy, which can also be quick to install. DTEK, Ukraine's largest commercial power generator, completed its first wind farm in May 2023 near Mykolaiv after less than 10 months of construction.

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