# Ukraine energy storage for microgrids

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On Feb. 24, 2022, Ukraine"s grid operators were entering into "island mode"--a state of autonomy from other neighboring grid systems--when their country was invaded by Russia. This shift was a test that was part of plans already underway for months to desynchronize from the Russian grid and synchronize with the European Union"s.

After the initial invasion, Ukraine operated in island mode until March 16, 2022, when the country was finally able to synchronize its grid to Europe"s. A massive undertaking, islanding then synchronizing a grid would typically take a country years--but Ukraine did it in a matter of weeks, made possible in part due to the technical assistance provided by the United States through the U.S. Agency for International Development (USAID) in the years leading up to, and months during and after, the island mode tests.

Grid operators "really made a huge difference when they decided to conduct the trial operation in island mode," said Kateryna Deikun-Stepanchuk, senior engineer in the Department of Balance Reliability at the Ukrainian power company, Transmission System Operator NPC Ukrenergo. "It was really challenging and dangerous, but nevertheless, our Ukrenergo team around all the regions of Ukraine became united in making it happen."

Grid stability is no easy feat even under the best of circumstances. Electric grids are delicately interconnected systems in which the supply of available energy and the use of that energy must be maintained in constant balance. Synchronizing one grid to another requires a precise match of the frequency, phase, and voltage of electric current. Failure to do so could result in grid collapse (a blackout) of both power systems and possibly require weeks of repair to make them functional.

Now, after more than a year of ongoing warfare, Ukraine"s power is still on. Crews from Ukrenergo are on call 24/7 to respond to targeted attacks on their grid infrastructure and to address local communities" needs within hours after a missile strike to get power flowing again.

All of this puts Ukraine"s power grid operators at the forefront of a multifront battle: "Our heroes are those people who keep our power system going," Deikun-Stepanchuk said.

Not only are grid operators maintaining critical wartime power services, but some have heeded the call to cross over into military operations. "There are many people in our company who joined the army. Very nice guys who work in our office and regional centers. Some of them are very young and could never have imagined that the time would come to hold a weapon in their hands! Never. But they joined the ranks of the Armed Forces," Deikun-Stepanchuk explained. "Unfortunately, we lost many of them. This is our pain. This is our sadness. And these are our heroes forever."

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Ukraine is maintaining light, heat, and other power needswhileits grid is constantly targeted by missiles and other attacks. Resilience--for the grid, for the people operating the grid, for Ukraine--is essential for the country now and as they look to the future.

Through USAID, the United States works with Ukraine"s government, energy private sector, and civil society to enhance Ukraine"s energy security and transform Ukraine"s energy sector into a modern, market-oriented, EU-integrated engine of growth. USAID is providing direct support to improve Ukraine"s energy policy, legal, and regulatory environment and makes direct investments in the electricity, gas, and heat sectors.

In partnership with USAID, the U.S. Department of Energy"s National Renewable Energy Laboratory (NREL) issupporting deployment of renewable-generation-based microgridsthat will enable Ukraine to increaseits energy independence and resilience by integrating more renewables intoits energy mix.

Ukraine"s aging grid has been a challenge to maintain even before the war brought targeted attacks. Before the invasion, NREL was supporting the USAID Ukraine mission and Ukrainian officials on modernization plans to transition to greater renewable energy penetration.

But "renewables don"t inherently make a grid more resilient," said Eliza Hotchkiss, researcher and resilience and energy security analyst at NREL. "They need to be designed to be more resilient."

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Web: https://www.hollanddutchtours.nl/contact-us/
Email: energystorage2000@gmail.com
WhatsApp: 8613816583346