Briefing

Solar to the rescue: photovoltaic energy systems can support Ukrainian communities and cities during the emergency response and in the longer term

February, 2023

Cases of recently installed photovoltaic energy facilities at objects of critical infrastructure have shown the potential of photovoltaics to provide a resilient energy source for years to come. Much more renewable energy equipment is necessary to scale up renewable energy production in Ukrainian communities and cities.

BACKGROUND

Since October 2022, massive Russian attacks have been destroying Ukraine's energy infrastructure and leaving millions of people freezing in the middle of winter. In response to the electricity shortages, the Ukrainian government and its international partners have focused their efforts on finding emergency solutions. These blackouts pose a major threat to the lives of the vulnerable by disrupting the operation of hospitals and medical facilities, including special care. For instance, since the beginning of the war, more than 1,000 medical facilities have been damaged and approximately 180 have been completely destroyed.

It is important to note that many public authorities have the intention to make their medical facilities energy resilient through the use of renewables and energy efficiency measures (see Annex 3). Energy efficiency requirements have been adopted in the new version of the state building regulations in 2022. However, there is a very high likelihood that such good intentions will be forgotten in the clamour to get the reconstruction done quickly.

Given the current circumstances, as a backup, deliveries of diesel and petrol generators for critical facilities or public 'points of resilience' where people receive basic services – such as phone charging, internet connection, heating, and lighting – are vital. However, fossil fuel generators are not sustainable – from a long-term perspective or on a broader scale. They have high running costs and depend on the availability of fuel.

- The cost of electricity paid by Ukrainians during outage hours from diesel generators is EUR 0.76 to 0.80 per kilowatt hour (kWh).[1] This is seven times higher than the price Ukrainian non-household consumers pay for electricity (EUR 0.11 per kWh) and five times higher than the price for non-household consumer in Germany (EUR 0.15 per kWh) in the first half of 2022.

- According to Berlin Economics,[2] a cost-optimal system for Ukraine's public facilities should include solar PV, batteries and some diesel generation capacity, while installing only diesel generators alone can be 40% more costly due to fuel costs.

1. The calculations was done by the Association of Energy Auditors of Ukraine based on the following formula:
(Equipment cost/Number of cycles/Energy per cycle) + Cost of charging energy (or fuel for generators per 1 kWh)
2. Berlin Economics, Policy Briefing Series: Keeping the lights on in times of grid outages Solar PV panels, battery storage systems and diesel generators, Berlin/Kyiv, 2023.

Gas and electricity prices are heavily subsidised by the government for most consumers as a contribution to addressing the humanitarian crisis. At the same time, such subsidies are one of the biggest barriers to energy efficiency projects and the deployment of renewable energy sources.

Certain favourable conditions like tax exemptions for imports and simplified procurement were introduced to make it easier to purchase generators and keep the country running. Yet according to Ukrenergo, the country's energy utility company, it might take as long as two years to fully restore a stable electricity supply to communities and cities. **The massive supply and installation of generators has been important to provide emergency electricity, but is expensive and unsustainable if used on a regular basis for several months following the emergency**. At the same time, one of the most practical alternatives – electricity storage systems – received far less attention. With the ability to charge the systems in the hours when electricity is available through the grid to use during blackouts, storage is a good alternative solution even if it is not connected to renewable sources like solar photovoltaic panels.

Meanwhile, solar energy systems with storage are now needed, as they would allow a high level of energy autonomy and resilience and could save precious financial resources for Ukrainian communities who have to deal with an avalanche of challenges at once. Such renewables-based systems are already being installed around the country.

Therefore, experts and civil society organisations are calling for diverse and alternative solutions such as renewable sources, particularly solar electricity, to be introduced as part of the emergency solution for critical infrastructure in the next one to two years with the goals of:

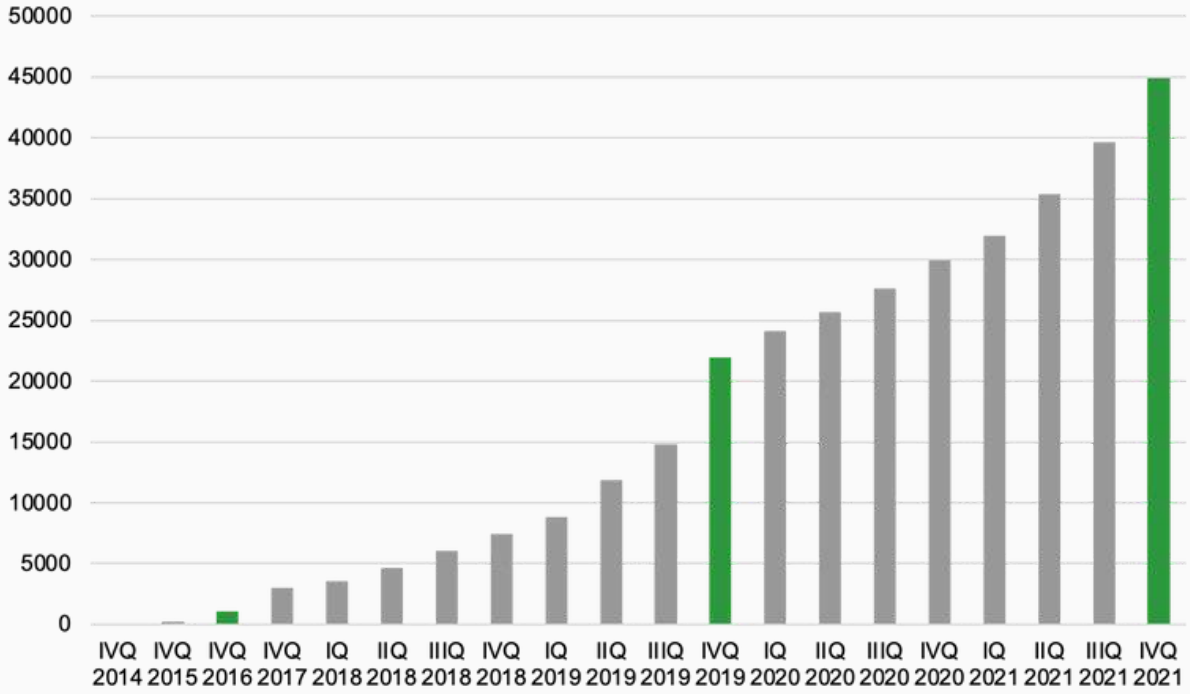
1. providing an emergency electricity supply throughout 2023;
2. contributing to more decentralised energy production and resilience based on sustainable and climate neutral technologies.

OPPORTUNITIES FOR RENEWABLE ENERGY SOURCES

At the beginning of 2022, the total installed renewable energy source capacity reached 9.5 gigawatts (GW), which generated 8 per cent of electricity in Ukraine – still a smaller share than that of fossil-based power production. Although there is no public data on the solar photovoltaic capacity installed on public facilities before Russia's full-scale invasion of Ukraine, data for other consumers such as households is available. According to the information provided by the State Agency on Energy Efficiency and Energy Saving of Ukraine, overall installed capacity of solar photovoltaic installations in households reached 1.2 GW and the number of such households was almost 45,000 at the end of 2021 (see Figure 1). The broad popular support for renewables as a reliable solution for energy supply and cost efficiency (see Annex 1) was confirmed in more recent opinion polls.

Overall, photovoltaic capacities of up to 50 kW can also be used as an independent back-up energy source for public buildings (see Annex 2). Despite the significant increase in installation of small-scale capacity by households over the last three years, however, small-scale solar installations still contribute a modest share in the total energy mix.

Figure 1. Total number of solar power installations in Ukrainian households, units



Source: State Agency on Energy Efficiency and Energy Saving of Ukraine (SAEE), 2022

In light of this trend towards small-scale solar photovoltaic installations, the potential for even more growth in the uptake of solar has only increased.

First, in mid-February 2023, the Ukrainian government registered the draft law to replace the existing feed-in tariff scheme with a net energy billing scheme. Although the Annual Implementation Report 2022 states that the thresholds for receiving the existing feed-in tariffs are not in line with EU State Aid rules and, therefore, cost Ukraine more money than necessary, the announced net billing mechanism is aimed at making small-scale projects more economically viable in the future. However, it should be noted that for Ukraine's recovery, the top priority for solar projects for critical infrastructure is to make facilities energy-independent and resilient, compared to commercial projects.

Second, water utilities offer another potential opportunity for the uptake of efficient renewable energy. Electricity outages mean that water supply and sewage are disrupted, which means that the humanitarian consequences of Russia's shelling are exacerbated. At the same time, water utilities are probably the most adapted to the use of uneven electricity generation from renewable sources. **Civil society organisations are currrently carrying out several small projects in Ukraine that explore these opportunities** (see Annex 3).

Third, despite the fact that climate targets are not the first priority for Ukraine under the current circumstances, sustainable forms of renewable energy need to be scaled up to support Ukrainians and keep up with global climate targets and EU 'renewable energy community' initiatives. In particular, Ukraine's 2030 renewable energy target is 27 per cent of renewables in gross final consumption of energy. Expanding and developing renewable energy generation for critical infrastructure in Ukraine will strengthen energy security and partnership with the European Union.

MAJOR ADVANTAGES OF SOLAR SYSTEMS FOR CRITICAL INFRASTRUCTURE

Resilience. There are already cases of solar plus storage solutions providing electricity for Ukrainian citizens and communities (see Annex 2) when the available grid is unavailable due to damage by military actions. These capacities are able to cover up to 40 to 60 per cent of electricity consumption (including communications, heating systems support, street lighting, etc.), even during the autumn-winter season.

Available ready-to-use PV equipment. In response to the unstable supply from the central grid and intermittency caused by rolling blackouts, Ukrainians have actively introduced electricity storage to their homes and public facilities. These systems consist of batteries and inverters that are often ready to integrate into solar photovoltaic systems. This will simplify the introduction of decentralised solar electricity production.

Long-term solutions. Local energy generation is a crucial step towards building a decentralised and smart energy grid, which will be more just, inclusive and resilient than the current one. In addition, solar photovoltaic systems are long-lasting, whereas diesel generators have to be either repaired or entirely replaced after a few years of intense use.

RECOMMENDATIONS

When addressing the energy emergency in Ukraine, international donors and partners should include renewable, and particularly solar, systems in humanitarian and emergency aid for critical infrastructure in Ukraine. Thus, we recommend these donors and partners:

- Compare renewable energy sources with fossil-fuel sources for energy infrastructure after receiving requests for energy supply equipment;
- Establish connections with renewable energy source equipment producers in Ukrainian regions to ensure supply channels for such equipment;
- Provide partial financial or equipment support for non-bankable initiatives;
- Establish low interest loan programmes for municipalities to enable the implementation of bankable projects;
- Provide support for non-governmental and municipal sector stakeholders for information and capacity development in the area of renewable energy source application during wartime and power blackouts.

Funders can establish cooperation on regional RES installations for interested parties through:

1. Direct connection with interested communities – see Annex 3 for a list of communities ready to cooperate;
2. Local non-governmental organisations – see examples in Annex 2;
3. Renewable business initiatives;
4. The Energy Community's Ukraine Energy Support Fund;
5. International financial institutions' (e.g. the EBRD, EIB, IFC, NEFCO) programmes and procurement of equipment, humanitarian support for energy, technical support programs operating in Ukraine (GIZ), or similar;
6. Providing guarantees on investments to renewables projects.

ANNEX 1. QUESTIONS AND ANSWERS ABOUT RENEWABLE ENERGY SOURCE

- **Can solar systems be delivered to Ukraine as humanitarian aid without additional taxes? What is the procedure?**

Currently, relevant legislation is in the process of adoption, which would allow for the import of solar systems and components to Ukraine without additional taxes. However, import tax and value-added tax (VAT) are still in place until the new legal provisions are adopted and signed.

- **What is the deployment time of renewable energy projects? When will they be operational?**

If all the necessary equipment is available, the project deployment time can be one to two weeks. However, it is important to keep in mind that procurement and logistics can be uncertain in Ukraine during wartime. This affects the overall timeline of implementing solar projects.

- **Will it still be possible to use solar during winter?**

Yes, solar photovoltaic stations also work during the winter season. Electricity generation is significantly lower due to shorter days and more clouds. However, energy generated and stored in batteries can still be used to power people's basic needs and enable institutions to provide their services (communication, internet access, administration, lighting, etc.).

- **What are the costs of the photovoltaic solutions?**

The average cost of ready to operate solar photovoltaic plus storage solutions in Ukraine is USD 1500 to 2000 per kW of installed capacity. However, each project's total costs are unique, requiring some form of a feasibility study before any decision-making. The costs may vary due to logistics and equipment availability. At the same time, partnerships with local solution providers can help lower the project's capital, logistics, and installation costs.

- **How can solar systems help people's safety?**

The current widespread use of diesel, petrol, etc. generators increased cases of carbon monoxide poisoning in Ukraine – around 370 cases of poisoning were registered in November 2022 alone. Therefore, renewables-based energy systems could provide a cleaner and less harmful power generation source.

- **Are there risks of corruption related to emergency energy equipment?**

Since 24 February 2022 and the beginning of martial law in Ukraine, the public procurement system has experienced significant changes – from overall cancellation in February and March to re-establishment in late June, but still with exemptions. The main goals for the changes were to make the purchases prompt, address military and other critical needs and avoid sharing sensitive information – however, this has inevitably led to a backslide in transparency and competition, risking potential overspending and corruption.

ANNEX 2. EXAMPLES OF IMPLEMENTED PROJECTS

Project 1. Hybrid solar power plant for emergency electricity supply needs on the roof of the Horenka hospital

Solar panels on the roof of Horenka hospital.
Source: Greenpeace

LOCATION: Hostomel community, Kyiv region.

INSTALLED CAPACITY: 12.6 kW with an 8-kWh storage system. Additionally, hybrid (5 kW) and grid connected (10 kW) inverters are installed.

EXPECTED PRODUCTION: 13,000 kWh per year, when grid-connected.

TOTAL COSTS: EUR 10 700 (EUR 7 000 – solar panels, EUR 3 700 – 8kWh of battery storage).

PROJECT INITIATED by non-governmental organisations (Greenpeace, Center for Environmental Initiatives 'Ecoaction', Ecoclub), in partnership with the charity fund Ukraine Victory, supported by Hostomel Military Administration and the communal non-commercial enterprise Hostomel Centre for Primary Health Care.

More details about the project: Center for Environmental Initiatives 'Ecoaction', Greenpeace

Source: Greenpeace

Project 2. Solar power plant with storage system, Irpin Academic Lyceum Mriya

Solar power plant in Irpin city.
Source: Energy Act for Ukraine

LOCATION: Irpin city, Kyiv region

INSTALLED CAPACITY: 20-kW solar power plant with a 20-kWh storage system (the storage system can be charged from the grid and/or from the solar power plant)**.**

TOTAL COSTS: EUR 48 000 (equipment provided by the German Solar Association; the installation was financed by the German Federal Foreign office).

PROJECT WAS REALISED VIA the campaign 100RESforSchools.

More details about the project:
Energy Act for Ukraine Foundation.

Project 3. Solar power plant for the water pumping station Mariina Roshcha

Solar station in Voznesensk (Southern Ukraine).
Source: NGO Ecoclub

LOCATION: Voznesensk Water Supply' Municipal Company, Voznesensk city, Mykolaiv region

INSTALLED CAPACITY: 50 kW (currently the plan is to expand its capacity to 200 kW)

EXPECTED ELECTRICITY PRODUCTION: 50-70 megawatt hours (MWh) per year (covering up to 15 per cent of the water pumping station's needs).

TOTAL COSTS: UAH 1.18 million invested– resources from municipal budget (38 per cent), the water company (37 per cent), grant support (25 per cent).

ESTIMATED SAVINGS IN 2022:
UAH 159 641 (EUR 4 100)

ESTIMATED GHG REDUCTION:
25,200 kilograms (kg) of CO2 eqivalent (yearly).

PROJECT WAS SUPPORTED by the NGO Ecoclub.

More details about the project: **Solar Plant for Voznesensk Water Supply System**

ANNEX 3. LIST OF COMMUNITIES READY TO COOPERATE

#	Name of the community/city	Type of system	Ready to co-finance the project	Contact via NGO
1	**Hostomel (school Lyceum No. 1), Kyiv region**	Solar photovoltaic panels for a school	Not sure	Greenpeace
2	**Chervonohrad, Lviv region**	Solar photovoltaic panels on critical social infrastructure and local town hall	Yes	Center for Environmental Initiatives 'Ecoaction'
3	**Novovolynsk, Volyn region**	Solar photovoltaic panels on a local hospital	Not sure	Center for Environmental Initiatives 'Ecoaction'
4	**Mykolaiv, Mykolaiv region**[3]	Solar photovoltaic panels for the water supply system	Yes, up to 50% of the costs	Ecoclub
5	**Pervomaisk, Kharkiv region**[3]	Solar photovoltaic panels on a local hospital	Need to clarify	Ecoclub
6	**Bilhorod-Dnistrovskyi, Odessa region**[3]	Solar photovoltaic panels on a local hospital	Yes	Ecoclub
7	**Voznesensk', Mykolaiv region**[3]	Solar photovoltaic panels on a local hospital	Yes	Ecoclub
8	**Dubno, Rivne region**[3]	Solar photovoltaic panels on a local hospital	Need to clarify	Ecoclub
9	**Zhmerynka, Vinnytsia region**[3]	Solar photovoltaic panels on a local hospital	Need to clarify	Ecoclub
10	**Kodyma, Odessa region**[3]	Solar photovoltaic panels on a local hospital	Need to clarify	Ecoclub
11	**Kolomyia, Ivano-Frankivsk region**[3]	Solar photovoltaic panels on a local hospital	Need to clarify	Ecoclub
12	**Korosten', Zhytomyr region**[3]	Solar photovoltaic panels on a local hospital	Need to clarify	Ecoclub
13	**Kremenchuk, Poltava region**[3]	Solar photovoltaic panels on a local hospital	Need to clarify	Ecoclub
14	**Myrgorod, Poltava region**[3]	Solar photovoltaic panels on a local hospital	Yes	Ecoclub
15	**Nizhyn, Chernihiv region**[3]	Solar photovoltaic panels on two local hospitals	Yes	Ecoclub
16	**Ovruch, Zhytomyr region**[3]	Solar photovoltaic panels on a local hospital	Yes	Ecoclub
17	**Podilsk, Odessa region**[3]	Solar photovoltaic panels on a local hospital	Need to clarify	Ecoclub
18	**Potava, Poltava region**[3]	Solar photovoltaic panels on three local hospitals	Need to clarify	Ecoclub
19	**Rivne, Rivne region**[3]	Solar photovoltaic panels on two local hospitals	Yes	Ecoclub
20	**Selydove, Donetsk region**[3]	Solar photovoltaic panels on a local hospital	Need to clarify	Ecoclub

3. Pre-feasibility studies have been prepared.

#	Name of the community/city	Type of system	Ready to co-finance the project	Contact via NGO
21	**Fastiv, Kyiv region**[3]	Solar photovoltaic panels on a local hospital	Need to clarify	Ecoclub
22	**Cherkasy, Cherkasy region**[3]	Solar photovoltaic panels on a local hospital	Yes	Ecoclub
23	**Chornomorsk, Odessa region**[3]	Solar photovoltaic panels on a local hospital	Yes	Ecoclub
24	**Zhytomyr, Zhytomyr region**[3]	Solar photovoltaic panels on a local hospital	Yes	Ecoclub
25	**Domanivsk, Mykolaiv region**[3]	Growing paulownia and its further use as fuel to replace fossil gas, utilszed to meet heating needs	Need to clarify	Ecoclub
26	**Kolomyia, Ivano-Frankivsk region**[3]	Cultivating energy willow for its further use as fuel to meet the need for heating state-finaced institutions in Kolomyia community and replacement of fossil gas	Need to clarify	Ecoclub
27	**Zvyhel', Zhytomyr region**[3]	Installation of a solar power plant on water supply company	Yes	Ecoclub
28	**Sumy, Sumy region**[3]	Construction of a solar power plant in the city of Sumy for the needs of the Elektroavtotrans municipal company	Yes	Ecoclub
29	**Brody, Lviv region**[3]	Installation of a solar power plant on water supply company	Yes	Ecoclub
30	**Nizhyn, Chernihiv region**[3]	Installation of a heat pump in a public building	Yes	Ecoclub
31	**Ostoh, Rivne region**[3]	Installation of a heat pump in a public building	Yes	Ecoclub
32	**Korosten', Zhytomyr region**[3]	Installation of a heat pump in a public building	Need to clarify	Ecoclub
33	**9 communal water supply enterprises**[4]	Installation of a solar power plant on water supply company	Need to clarify	Ecoclub

3. Pre-feasibility studies have been prepared.

4. There is a selection of communities for the preparation of pre-feasibility study.

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