

The Resilience of Local Rural Communities Facing the Destruction of Centralised Energy Infrastructure

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Summary

The high risks of ongoing electricity supply suspension due to Russian targeted attacks on the critical infrastructure of Ukraine actualise the solutions for the independence of critical functions of local communities from centralised energy supply. International and national aid provision is usually concentrated on urban communities. Meanwhile, the resilience of rural communities is not less important, especially due to the crucial role of rural areas in food security and their potential to shelter a part of city dwellers during periods of heavy blackouts.

The resilience required to enable local rural communities to independently cover the urgent needs in energy supply to provide critically important functions, rationalise energy spending by energy-efficient modernisation and engage the locally produced bioenergetic potential.

Solving Ukraine's energy resilience issues represents the important track of prospective long-term Ukraine-EU cooperation, in particular – bringing new value-added to EU Recovery and Resilience Facility.

Problem

Russia's targeted attacks on the energy infrastructure of Ukraine hit the electricity supply throughout the country, and the recovery of the energy system becomes increasingly technically complicated after each next attack. Thus, central government and local officials warned their communities of the **probability of full electricity blackouts for a significant period of time** and, respectively, to envisage the capacity to pass through this challenging period with the smallest losses.

In a modern economy, the lack of electricity leads to complex systemic economic and social problems caused by possible interruptions in heating and water supply, transport communications, telecommunications (including mobile and

broadband Internet), provision of banking services, retail networks' functioning, and fuel supply, amongst many more.

The consequences of blackouts are much more sensitive for large cities, where they cause practically immediate stopping of water supply and, highly likely, centralised heating, paralyse the provision of a large part of everyday services (e.g., card payments and cash machines). In fact, rural communities are much more resilient in the case of centralised energy supply suspension. Meanwhile, in the case of too prolonged absence of electricity supply, the accumulation of systemic problems mentioned above is inevitable. In addition, **de-energising rural consumers can bring new risks to food security, endangering the conditions of agriproducts' storage, processing, transport delivery, and the like.**

In case of severe blackouts, one can expect a significant outflow of city dwellers to rural locations – using their second houses, relatives, and friends’ invitations. In the worst cases, partial evacuation from large cities for temporary placement of people in heated public buildings such as schools and hospitals **is considered**. In this case, the local rural infrastructure, already suffering from the blackout, will be additionally loaded by new consumers. And its resilience becomes even more critical.

In fact, the proper recovery of standard quality electricity supply requires quite a long time and, **as estimated**, will last even long after the war finishes. Thus, necessary recovery works cannot be considered the basis of resilience. The problems should be mitigated through alternative steps for urgent and short-term periods.

It is essential to keep in mind that, besides the urgent one, the problem has a prolonged dimension. **Energy deficit will be actual not only in periods of attack but even more in the recovery period when restoring the normal functioning of the energy system will still require significant time. In contrast, the demand for energy will rapidly grow due to intense recovery and rebuilding works, and restarts of currently stopped or newly built enterprises.** Thus, temporary electricity switch-offs due to its deficit will likely still be the reality in the early post-war period and can imply their limitations on the post-war recovery.

Power generators are a good urgent solution, but they also generate problems associated with risks for the availability of fuel, the high cost of produced electricity, and engines’ maintenance. More convenient, reliable, and long-lasting instruments of resilience should be implemented.

Purpose

Strengthening the resilience of local rural communities facing the destruction of centralised energy supply plays an extraordinary role in preventing a humanitarian crisis, ensuring food security and economic sustainability in war, and providing solid ground for rapid post-war recovery. The purpose is to ensure the accessible temporary substitutes of centralised power supply are sustainable in the medium-term period. The increase in the share of local energy sources available at local

communities’ disposal should allow for optimising the cost of central electricity supply substitution.

The local communities must be provided with the capacities to ensure critical power supply, involving available alternative resources in a short perspective, and to realise the necessary modernisation measures, optimising energy consumption and energy supply based on local sources in the medium run.

It is crucial to separate: first, the strategically-oriented permanent modernisation of energy production and supply, which is often accompanied by technological, legislative, and organisational limitations aimed at saving the integrity of the energy system: second - urgent solutions which build the parallel energy feeding systems, in mayor cases – not intended to be integrated into the energy system but to persist as emergency ones.

Households must be capable to provide energy modernisation of dwellings and to implement the available alternative power sources (for electricity and heating).

As the basis of reloading the local communities of Ukraine’s energy resilience, we consider the boost of the previously underutilised bioenergy potential contained in energy plants, planting and animal husbandry and wood production residues, and processing solid waste (see **Annex**). The process should be started immediately, also considering the new wave beginning with the 2023 agrarian season.

Recommendations

Strengthen the capacity of local rural communities to cover the urgent needs in the provision of critically essential functions independently on centralised power supply sources and to optimise the distribution of limited centralised power supply. The recommended measures are:

- **Mapping of critical points where alternative, independent electricity supply is obligatory, such as: official “points of implacability”** (public shelters with acting heating, electricity, water stocks, communication services), medical facilities, centres of public services, water supply and sewage pumps, and centralised heating facilities). The list could be created based on consultations with the Ministry for Communities and Territories Development and interviews with

local self-governments based on standardised checklists. With these, the circles of priority could be selected (e.g., points which need alternative supply immediately in case of prolonged power suspension, constantly or on a periodical schedule, as in case of water towers filling);

- **Managing the provision of all the determined critical points with stationary or mobile generators and appropriate fuel supply** (reserves stored in special facilities), with the help of international aid, peer-to-peer contacts with municipalities of European countries, grants from international foundations, sponsoring by business entities, and crowdfunding. The implication of the agreed mechanisms **of European countries' patronage** over the recovery of Ukrainian regions can be promising in this case;
- **Promoting the agreements between local self-governments and private providers of crucial services**, such as retail trading companies, gas stations, providers of mobile communication and broadband Internet, bank branches, and waste management companies, concerning joint efforts in strengthening their energy resilience, particularly in purchasing generating and storage facilities and fuel;
- **Supporting technical and legislative (permissions) of transmission lines improvement and connectors**, in order to enable more flexible management regarding switching-off consumers. Also essential is allowing temporary supply schemes to engage with special urgent supply lines for critical points. The local self-governance should be involved in tailoring the decisions of planned fan switch-offs and allowed to prioritise the consumers in local distribution grids in emergency and planned switch-offs;
- **Rapid assessment of the existing facilities of local communities to start and intensify the production of bioenergy.** In particular, it should focus on the available local resource's potential and existing capacities that can boost biofuel production or be reconstructed for such production. The same applies to energy, whether heat or electricity production from biofuel, available building and sites that can be used to install bioenergy production, and the local and subregional potential of consumption;

- **Promotion of grants and investments into local bioenergy production:** as part of international aid, in P2P inter-municipal relations, as business projects based on PPP instruments and cooperative investments, and as additional investments by companies whose bioenergy raw materials are its byproduct. Tax incentives and subsidised credits are recommended as support measures at the government level.

Support the improvement of energy efficiency of public and residential buildings and private houses to reduce energy consumption and use diversified energy sources. The measures are applicable for rural areas and small towns, the same as for large cities. However, the scale of work to be done in less urbanised areas is much bigger. For this reason:

- **Provide the support of local communities in realising energy efficiency projects** for renovating public buildings where applicable, such as for recovery after war damages. This can range from the budgetary fund of liquidation and the consequences of armed aggression (UAH 35,5 bln for 2023) to local budgets and international aid programs;
- **Provide informational, legal, and organisational support for the energy modernisation of households:** free energy audits, informing households about available solutions, the quick arrangement of necessary permissions and registrations, and the development of supportive infrastructures, such as smart grids, to name a few.
- **Offer households assistance to prepare applications** necessary to receive grants, "warm" (energy-efficient) bank credits, subsidies for the renovation of dwellings, and energy equipment;
- **Organise open demonstrations and pilot projects with interested Ukrainian and foreign energy producers** renovating public and private buildings.

Boost the technological basis for local bioenergy production based on available and potentially possible localised resources together with appropriate storage, distribution, and producer-consumer network infrastructure. The central part of the projects is likely to be realised no earlier than spring 2023 or in post-war recovery programs, but the initial phases should be realised as soon as possible. The recommended priorities are:

- **Distinguish the particular separate track in the programs of international support on Ukraine,** aimed to implement bioenergy resources' collection, processing and engagement in heating and generation to substitute fossil fuels and centralised electricity supply;
- **Promote the national production and the import of small-sized and mobile equipment** designed to produce biofuel from local residues and low-quality products, such as oil cake, beet pulp, sawdust, wood chips, technical oil seeds, corn, and wheat;
- **Develop cooperation with European countries who are leaders in biofuel production,** such as France, Denmark, the Netherlands, and the UK, in acquiring and adapting the technologies of processing the resources for biofuel, biofuel production, storage, distribution and efficient usage, personnel training, safety, and environmental issue-solving;
- **Implement into the animal husbandry recovery and development policy the track of biogas production, storage and usage;**
- **Consider the prospect of a radical increase of energy plants cultivated** at the expense of land, heavily polluted as battlefields (after their demining) and unsuitable for some period for food products' planting. The compatibility of this kind of land's engagement with post-war restoration should be studied to choose the most appropriate cultures, such as paulownia, energy willow and poplar, sorghum, or rapeseed;
- **Accelerate the solid waste management programs and processing** in energy products based on inter-municipal cooperation on waste management.

Conclusion

The resilience of local rural communities facing the destruction of centralised energy infrastructure should be the outcome of the complementary actions of local communities in tight contact with local businesses. It should also be strongly supported by the Ukrainian Government and international partners. The importance of this resilience scales beyond the local level and is one of the cornerstones of the nation's resilience in this war.

For a proper and balanced reaction to urgent needs, the coordination of international aid is needed. Thus, productive is the **idea of "economic Rammstein"** – the systematic consultations concerning the technical and financial support for Ukraine and logistics provision. Also, peer-to-peer communication based on inter-municipal contacts, previously established business partnerships, and actions of civic and humanitarian organisations in the EU and Ukraine can all be of great help.

Solving Ukraine's energy resilience issues represents the prospective sphere of initiating the important track of long-term Ukraine-EU cooperation – as it is complementary to the goals of the EU **Recovery and Resilience Facility (RRF)** of 2021, enforced in 2022 by the **REPowerEU** track. The projects, already initiated by EU countries within their **National Recovery and Resilience Plans**, could be scaled up to the terrains of Ukraine by:

- **Implementing pilot projects,** testing specific solutions in energy resilience, "green" transition, and digital transformations. This testing in Ukraine can be easier starting from scratch, based on main resources that are cheaper than in the EU;
- **Implementing technological and organisational solutions** prepared by European companies in the fields of energy resilience, in particular, alternative and renewable energy sources, storage, and the efficient delivery of renewable energy. The purchases of respective technologies, equipment, and implementation works can be part of the packages of European aid to Ukraine. Scaling the results of European companies obtained within RRF will increase the positive impact of this program for the post-crisis revival of the EU economy.

Using the narratives written in this paper, broadening expert and political communications between Ukrainian and European governments and self-governance institutions, businesses, and service providers should promote the realisation of the cooperative potential of the energy resilience track. The studies and expert exchanges on the modern European experience, expert communicative events, and technical aid at the inter-municipal level will be helpful. **As practical priorities, the following non-exhaustive list from RRF guidelines is suggested:**

- The energy renovation of public and residential buildings, energy efficient principles of new construction;
- The decentralisation of heating systems (local district heating);
- The implementation of local renewable energy sources (primarily biofuel);
- Waste management and solid waste recycling;
- Smart grids.

Ukraine's involvement in the process of RRF's implementation will positively reflect on the realisation of national plans and general value-added of RRF for the EU, improving the background of Ukraine-EU economic communications. **Consequently, this can provide a ground for conversations on Ukraine's further direct participation in RRF.**

Annexe

Bioenergy Potential of Ukraine

(Based on the **survey of the National Institute for Strategic Studies**)

According to the Energy Balance of Ukraine data on thermal energy production, the share of biofuel in 2020 was less than 5 %, **compared with 60 %** in Sweden, 31 % in Austria, and 15 % in Latvia. The agrarian sector's and manufacturing's potential to partially substitute traditional energy sources with biofuel is strongly underutilised.

Meanwhile, the engagement of biofuel for heat and energy generation is quickly growing in Ukraine. In 2020, **biomass already substituted** about 15 % of total natural gas consumption, with approximately 10 % of houses in Ukraine heated by it. **70 % of all bioenergy** is received from solid biomass burning, with 15% - from biogas and 15 % - from bioethanol and biodiesel.

Globally, 64 % of world bioethanol is produced from corn, 37 % of biodiesel from rapeseed oil, and 27% from soy oil. These cultures represent part of Ukraine's agrarian specialisation that is now exported in raw or as technical oil, proving the huge potential of bioenergetics of the country. Also, in 2021 4,8 mln tonnes of oil cake and other solid oil and fats' extraction residuals have been exported. In 2019, only 22 % of the total built biodiesel production capacities **were engaged in production**.

In total, Ukraine's biomass' economically feasible energy potential reaches 2025 mln tonnes of conventional fuel per year. Experts emphasize the following potential opportunities for biofuel production in Ukraine:

- 1. Cultivating energy plants:** annuals, like sorghum, miscanthus, rapeseed, perennials, paulownia, energy willow, and energy poplar. It is important that energy plants can be cultivated on land that is inconvenient for food production. To prevent erosion, some of them, such as the energy willow, **can improve the productivity of the soil**. According to **expert estimates**, energy cultures' cultivation at 1 million hectares (in total, Ukraine has 42,7 million hectares of agricultural land) can substitute one-half of all imported by Ukraine's natural gas.
- 2. Using crop production residues**, such as grain straw, sunflower and corn stalks. Experts believe that by these sources, 13-15 % of the primary energy needs of the country can be covered.
- 3. Using sugarbeet for biofuel production** – direct bioethanol production or biogas from sugarbeet pulp– for the own needs of the plants and local settlements' heating. The total possible biogas production of sugar plants (actual for 2013) **is estimated** at 33,5 million m³ of biogas.
- 4. Recycling of animal husbandry production residues** for biogas, particularly cattle and pig manure.
- 5. Wood production residues** – sawdust, chips, bark, results of sanitary forest cleaning.
- 6. Solid waste recycling**, including current waste flows and deposits, accumulated at open-air dumps.

According to **2019 data**, the total biogas production in Ukraine accounted for about 100 mln m³ per year. Only 34 % of the energy potential of this biogas was converted into useful electricity and heat. The estimated potential of 10 billion m³ per year of biomethane production **is sufficient** to cover all of Ukraine's natural gas needs and partially motor fuel.

In Lviv and Zhytomyr, the construction of combined heat and power plants, based on wood chips and refuse-derived fuel – totalling 90 MWt of heat and 11 MWt of electric energy and planned to start operation in 2023, **has been stated**. Also, nine heat and power plants and bio boilers in eight regions of Ukraine are projected to total 250 MWt of heat and 52 MWt of electric energy.