

## The Executive Summary - MARKET ASSESSMENT OF SMALL HYDRO POWER PLANTS IN UKRAINE

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### Background

According to UkrHydroProject (UHP), a local research institute, Ukraine has a major under-developed hydropower resource in its nearly 63,000 small rivers; which accounts for up to 28 percent of the country's total hydropower potential. Small hydropower potential was estimated at 2,900 GWh/year. Around 64 small hydropower plants (capacity less than 10 MW) were operating in 2011, with a total capacity of only 104 MW, generating around 250 GWh/year. There were also about 100 small hydropower stations that were not operational but could be restored. Many of these stations have been neglected and went into disrepair during decades when abundant supply of natural gas and other fossil fuels are available both from Russia and Ukraine itself. The potential of small rivers in Zakarpatska, Lvivska and Chernivetska Oblasts was barely used.

The Bank's engagement in Ukrainian hydro sector has been focused on large hydro projects including rehabilitation of large hydropower stations on cascade of Dnieper and Dniester rivers. It was clear that big rivers' potential has been almost fully exhausted with over 4,700 MW of installed hydropower capacity, the majority being large hydro and pump storage stations, eight of which are on the Dnipro River with a total capacity of 4,084 MW and two on the Dniester River with 1,674 MW with 103 hydro generation units installed and operating.

On February 2017 World Bank team jointly with IFC initiated the activity, Market Assessment of Small Hydro Rehabilitation in Ukraine, to explore the possibility to develop small and mini hydropower in Ukraine with strong believe that this would encourage the decarbonization of the country's energy system and help address providing power in hard-to-reach rural areas. The team has set a main direction for further hydro development in rehabilitation of existing hydro plants and construction of new small hydro financed primarily by private investors and possibly with support of IFIs.

### Activity Objectives and Scopes

The activity was aimed at supporting the Government of Ukraine in conducting a market assessment of small hydropower resources, both for existing sites and selected new ones, and in developing a policy and regulatory framework for scaling up public and private investment in small hydropower projects. The activity has carried out the following tasks:

- (i) Analyzed recent studies on small hydro rehabilitation in Ukraine by local and international organizations. The results were summarized by the following categories: potential rehabilitable resources by site, potential new construction by site, investments in rehabilitation and rehabilitated capacity/sites since 2000, economics of rehabilitated and newly constructed small hydro sites, main types of financing and implementation arrangements, and lessons learned (technical, economic, financing and implementation);
- (ii) Reviewed Ukraine's policy and regulatory framework for supporting small hydro development and compare it with the most effective supporting frameworks used in other countries;
- (iii) Conducted a brief inventory of existing hydrological/hydrometric measurements (such as discharge measurements and river cross-section surveys) and other relevant data at the available hydrological stations, and assess the data quality and completeness, including identification of data gaps and formulation of recommendations for achieving the data completeness and accuracy necessary to support decisions on the proposed small hydro rehabilitation/development;
- (iv) Conducted an assessment/screening of a long list of potential project sites (including selected rehabilitated sites and selected sites for new construction) to gain key insights on the technical, economic, environmental, engineering, and implementation issues involved and select a smaller sample of the most promising sites for a more detailed analysis of potential investment projects;

- (v) Conducted a financial analysis of potential investment projects at the selected sites from a private sector perspective, under the current policy and regulatory framework, with due consideration of applicable environmental and social safeguards;
- (vi) Conducted interviews and meetings with investors, equipment suppliers, engineering firms, financiers, regulators and policy makers to gauge interest in, understand constraints to, and discuss solutions for scaling up small hydro rehabilitation/new small hydro construction; and
- (vii) Proposed options for scaling up investments in small hydro rehabilitation/construction, including ways (policies, regulations, incentives) to close the financial viability gap (FVG), i.e. to make small hydropower feasible for private sector investments participating on a fully commercial or PPP basis, while ensuring compliance with applicable environmental and social safeguards.

## Main Findings

### **Small Hydro Power (SHP) has untapped RE potential in some regions of Ukraine, which could be utilized.**

Although SHP is generally considered as a mature technology, the industry needs continuous infusions of new ideas and technology to ensure that SHP maintains and enhances its contributions to the emissions-free, indigenous electricity generation, and that hydro facilities operate in harmony with the environment.

**The market share of SHP<sup>1</sup> in Ukraine Power System is marginal,** in 2017, SHP provided 0.14% of total electricity production accounting for around 0.2% of the total installed capacity. According to data from the Ukrainian Regulator (NEURC), in 2018 there were 143 SHPPs operating at the green tariff with the total installed capacity of 96.8 MW.

**The result of the study shows technical potential for development of SHP in Ukraine, estimated at 280 MW,** which is not as large as was considered earlier by UNDP (estimated at 2000 MW), but still SHP in Ukraine poses an advantage compared with solar as the estimated cost for SHP is 9.4 US Cent/kWh, based on a developed Levelized Cost of Electricity (LCOE) model, compared with 9.8 US Cent/kWh for solar power, and wind power is assessed at 7 cent/kWh. While the LCOE was carried out for two sets of cost assumptions (one developed based on data from SHP Developers and another one from UHP), the higher cost scenario from UHP could not be validated/verified and was hence was ignored.

**Based on UkrHydroProject Detailed assessment of two regions – Lviv and Kkarkiv study identified that the Lviv region has the highest SHP potential but most of them are not economically and environmentally viable.** The Lviv region has 135 potential sites for SHP and estimated total capacity of 137 MW. At the same time, the list of potential SHPPs in Lviv region contains a large number of projects that have realistically low chance for implementation for environmental or economic reasons. These projects have small installed capacities and require high CAPEX which cannot be recovered. Other sites that have high potential will be used for the further work on preparation of full Feasibility Study and design documents to realize those projects.

**Main risks associated with SHP development are:** (i) high capital costs and long implementation time from project initiation to start of operation, (ii) environmental and social risks, mostly related to large reservoirs to be developed for SHP, and flood risks, which would be environmentally and socially problematic, (iii) economic advantages of competing RE energy resources, wind and solar power compared to SHP, and (iv) requirements to adopt regulations for the construction and operation of SHPPs.

**There is a need to consider amendments to an existing law concerning a strategic view for SHP development to be introduced to the Hydropower Development Program for the period up to 2026.** The respective amendments

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<sup>1</sup> Under Ukrainian law, a small-scale hydropower plant is the one with the capacity of 1 to 10MW.

should be prepared by the Ministry of Energy and Coal Industry (MoECI) necessarily involving the regional authorities. Details of the amendments/changes required are presented in main Report of the MARKET ASSESSMENT OF SMALL HYDRO POWER PLANTS IN UKRAINE. At the same time, such activity should be guided and supervised by the Cabinet of Ministers of Ukraine in order to avoid delays in obtaining data and information from local authorities about operational SHPPs or potential SHPP sites.

**The Study concluded that SHP in Ukraine will obviously not take up a significant market share of generation capacity, but can help in addressing the needs of Ukraine's energy system** in producing clean electricity and can also make important contributions to water, food security and to climate resilience with properly designed instruments of mitigation of the above referenced risks. WBG's role going forward is help in addressing identified risks as well as designing enabling environment for development of small hydropower along other renewable energy sources and conventional power generation technology.

### Next Steps

The Bank will seek funding from ESMAP and from other Development Partners (IFIs and Bilateral Institutions) active in Ukraine to support the government in the removal of existing legal and regulatory bottlenecks identified during this study and addressing risks and developing an efficient regulatory system.