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ENABLERS AND BARRIERS FOR SMALL HYDROPOWER DEVELOPMENT IN UKRAINE

Abstract. The report presents key enablers and barriers for the sustainable development of small hydropower in Ukraine.

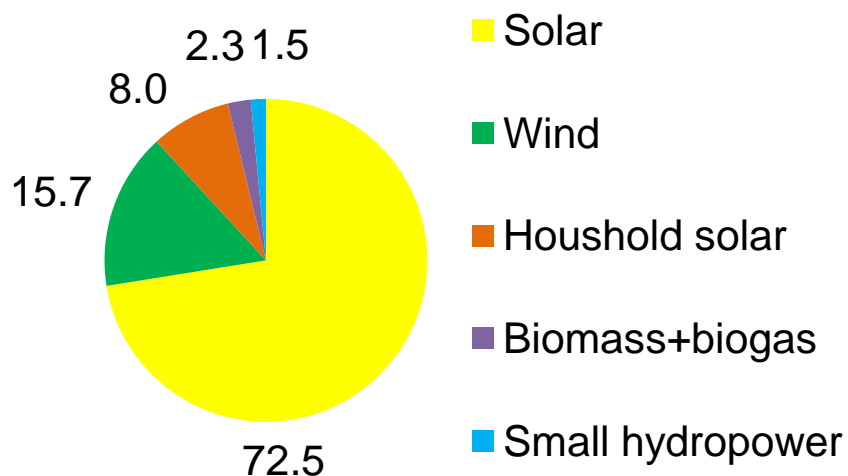
Keywords: environmental issues, feed-in-tariff, small hydropower, good case practices

Introduction

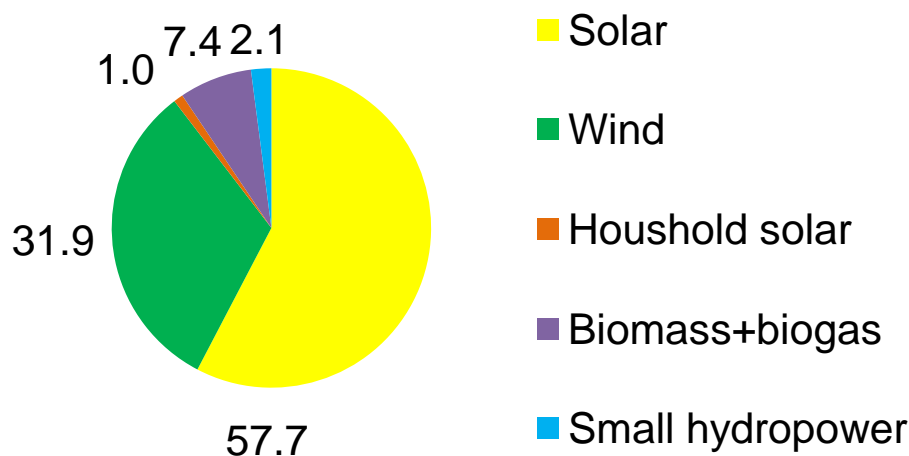
Ukraine has hydropower potential for the development of small hydropower (SHP). First of all, it is attributed to the large number of small and medium-sized rivers flowing through its territory (more than 55,000) [1]. There are also 1103 reservoirs in Ukraine with a total water volume of about 55,500 million m³, and 50,793 artificial ponds (a pond has capacity not exceeding 1.0 million m³) with a total volume of 3,969 million m³ [2, 3]. The recent results of the market assessment of SHP rehabilitation in Ukraine study from World Bank shows the total feasible hydro potential for Ukraine's SHP development including approximately 119 MW developed [4] of about 280 MW [5]. **That is, at least 58 per cent of the feasible potential of SHP remains untapped in Ukraine.** Thus, opportunities for further development of SHP in the country still exist. In addition, **the key enabler for the development of SHP in Ukraine should still be considered its state support, in particular through its eligibility to benefit from the feed-in-tariff (FIT) [6, 7].**

However, at present the share of SHP installed capacity and electricity generation in Ukraine's Integrated Power System (IPS) compared with other renewable sources using FIT **is marginal**.

Installed capacity of Ukraine's non-traditional renewable energy (%) as of April, 2020



Annual electricity generation of Ukraine's non-traditional renewable energy (%) as of the end of 2020



There was a significant reduction in the share of SHP in the installed capacity mix of non-traditional renewable energy in Ukraine's IPS. From 2010 till the first quarter of 2020 this share decreased from 43.0 per cent to 1.5 per cent.

Formulation of the problem

Overall, Ukraine's current regulatory framework keeps providing good opportunities for the SHP development in the country. **However, Ukraine's SHP develops spontaneously, without due regard for environmental issues, local needs, and without feasibility assessment of many SHP projects.** Primarily, it is because **there is no national SHP development programme in Ukraine yet.** It could be a significant challenge in the future. As the WWF in Ukraine emphasises, “despite the high impact of SHP on the river environment and ecosystem services, public money in the shape of green tariffs is driving further development and the provision of financial support is not linked to environmental and social conditions” [8, 9].

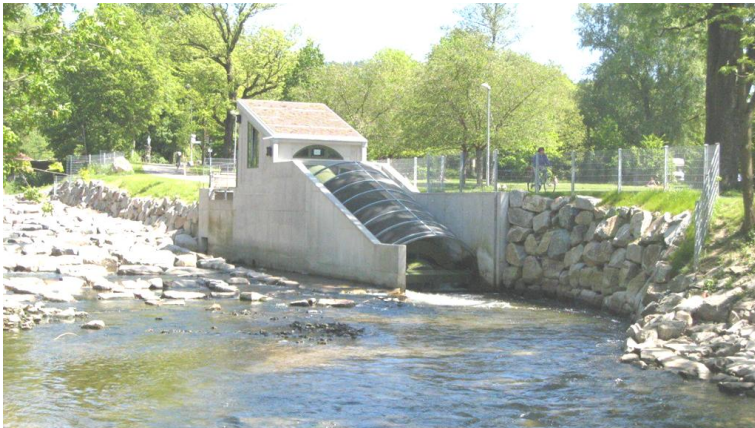
Some examples to compare SHPPs with fish passages



Water intake structure with “fish ladder” of the Probiynivs'ka SHPP-2 (232 kW) (photo by O. Vasyliuk)



Water intake structure with “fish ladder” of the Nizhniy Bystryi SHPP-2 (232 kW) (photo by O. Stankevich-Volosyanchuk)



An example of a typical implementation of SHPP with the fish passage in Germany

What should we do?

Ukraine needs a special SHP development programme. It should be developed with the involvement of all stakeholders including scientists, local community and non-governance organizations to ensure coordination of different concerns, making of knowledge-based decisions and finding of feasible trade-offs. **When developing such programme it will be possible to determine “no-go” areas [8] for hydropower development, and also ensure unlocking so-called “hidden hydropower potential”.** It relates to a lot of non-powered dams in the country, municipal and industrial reservoirs and ponds, sewage and wastewater treatment runoff pipes infrastructure and other man-made water infrastructure for the distribution of water for agricultural or other purposes. **This hidden hydropower potential has not been explored in the country yet.** Its usage might boost the implementation of successful SHP projects without harming largely the environment and local communities [8, 9].

Examples of untapped “hidden hydropower potential”, the Horyn’ River, Rivne region



The sluice-regulator near the village of
Voskodavy



The sluice-regulator near the village of
Metkiv

Examples of good case practice of unlocking “hidden hydropower potential”

There have already been two good case practices relating to SHP in wastewater treatment facilities in Ukraine, which are pilot projects in the country. One small hydraulic installation is located in the city of Poltava at the Suprunivska sewage treatment plant [4]. The hydropower unit using treated wastewaters has a capacity of 190 kW and produces up to 1.24 million kWh of electricity per year. This project was supported by the Ukrainian office of the WWF and was implemented in 2018. The second case was also implemented in 2018 in the city of Zaporizhzhia on the Kapustyansky sludge reservoir [4]. The main structures of the reservoir were built in the 60s of the last century to accumulate sludge from wastewaters and water clarification before discharging to the river. That SHPP has a capacity of 484 kW and generates up to 2.1 million kWh of electricity per year.

Poltava SHPP at the Suprunivska sewage treatment plant



Installed capacity is 190 kW;
Design head is 36 m;
Design discharge is 0.7 m³/s;
Expected electricity generation per year is 1.24 million kWh;
The installed capacity utilization rate is about 75 per cent

2-chamber Crossflow turbine (198 kW)
Generator Asynchronous (192 kW)

The Crossflow two-chamber turbine works at water discharge from 17% to 100% with high efficiency. The water supply to the turbine is regulated automatically, there is no personnel. The turbine bearings are located outside the turbine housing, which prevents oil from entering the water.

The cost of the project is approximately 500,000 Euros.

Zaporizhzh's'ka SHPP on the Kapustyansky sludge reservoir



Installed capacity is 484 kW;
Design head is 32 m;
Design discharge is 2.0 m³/s;
Expected electricity generation per year is 2.1 million kWh;
The installed capacity utilization rate is about 75 per cent



The reservoir is equipped with an automated bypass system in case the SHPP will not work. Due to this system, water can be freely discharged from the sludge reservoir. The total cost of the project is approximately 1,000,000 Euros

2-chamber Crossflow turbine (520 kW)
Generator Asynchronous (500 kW)

Some conclusions

Actually, environmental issues caused by previous unsuccessful hydropower projects, which had harmed rivers and local ecosystems and ignored the interests of local communities and other water users [6-11], are among the main barriers that hinder the stable development of hydropower in Ukraine. **It should also be noted that environmental impact assessments conducting in Ukraine for new SHP projects turn out to be often inadequate and insufficiently comprehensive [10].** They do not enable properly analyze and estimate alternatives, and implement appropriate compensatory measures. As a result, environmentalists and local communities show a significant resistance to the further SHP development in the country [6-11].

The next barrier relates to the relatively poor natural hydropower potential, especially for SHP. For local rivers, it is one of the lowest in the world [6]. Small and medium-sized rivers flowing through the territory of Ukraine show a relatively low and uneven runoff (up to 70 per cent or more of their annual runoff occurs during short periods of floods). In addition, most rivers, where SHPPs are situated, flow on the plain areas with relatively small height difference from source to mouth. For example, for rivers of the Dnieper basin, it does not exceed 50-70 m, the Southern Bug basin - 100-150 m. In Carpathians, rivers have a slightly greater overall height difference downstream, but it does not exceed 300-400 m in turn. As well, it should be taken into account the water shortage issue because of climate change that may also be a critical one for Ukraine's small hydropower.

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**Thank you very much for
attention!**