Marszelewski, Michal; Piasecki, Adam

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Toward to "Green Deal" Legal and Natural Aspects of the Development of Small Hydropower Plants - The Example of Poland

Michał Marszelewski[1]*, Adam Piasecki[2]

[1]Faculty of Law and Administration, Nicolaus Copernicus University in Toruń, Poland, [2]Faculty of Earth Sciences and Spatial Management, Nicolaus Copernicus University in Toruń, Poland. *Email: marszelewski@umk.pl

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ABSTRACT

The article contains a legal-environmental analysis covering the development and operational aspects of small hydropower plants (SHPs) in Poland. From legal perspective, the paper presents conditions that have to be met during the investment process. It was shown that such a process is highly formalized. The need to protect the water and the environment results in necessity to obtain various administration decisions like water permits or decision on environmental conditions. Second discussed law-related field is the support system. In Poland there are three categories of SHPs support system: green certificates, auction system and feed-in tariff (FIT) or feed-in premium (FIP) system. The last one is the most optimal for SHPs and significantly helps to make them profitable. Moving on to an environmental perspective, Polish topography is relatively unfavorable for SHPs because of water resources and significant part of flat lowlands. Taking into account that SHP may have a visible impact on ecosystems and – in most cases – are localized and managed by private entities, it is crucial to use the SHPs potential in Poland as effective as possible. Conducted analysis also shown the legal regulation should be changed to more friendly for SHPs operators.

Keywords: Small Hydropower Plant, Shp, Polish Law, Feed-in Tariff, Feed-in Premium, Ecology, Environment, European Climate Law
JEL Classifications: Q25, O10, K32, K39

1. INTRODUCTION

Hydropower plants are among the most commonly used types of renewable energy sources, providing around 20% of the world's total electricity. In terms of capacity, power plants are categorised as small or large. Hydro-electric power production usually exploits the energy of falling water or river velocity (King, 2018; Sensibe et al., 2018; Wieteska et al., 2018).

A small hydropower plant (SHP) has been described as a "well-developed small-scale renewable energy technology that can provide safe and clean electricity to rural and urban areas" (Warren, 2017). There is no globally or internationally agreed definition of an SHP (Warren, 2017; Lowenstein and Panarella, 2018; Mesquita 2019). Moreover, there are differences in the classifications adopted in different countries of Europe (Mesquita 2019). EU Member States recognise installations with a maximum capacity of 10 MW as SHPs, while Greece even counts 15 MW units as such. By contrast, in Sweden and Germany, an SHP is considered to be an installation with a capacity of less than or equal to 3 MW (Mesquita 2019). In Poland, there is no legal definition of maximum SHP capacity. However, there is a definition of a small "renewable energy source" (RES) installation that covers all installations of up to 0.5 MW. In this context, 5 MW is widely accepted in Poland as the maximum for an SHP (Malicka, 2018; Świątek 2016, PGA 2021). In the USA, definitions vary from state to state (King, 2018), despite the term "small hydroelectric power project" having been statutorily defined by the US Congress. It is set as an installation with a capacity of 10 MW or less that generates electricity through using an existing dam or a natural water feature such as a natural lake, waterfall or the gradient of a natural stream, without utilizing a dam, a man-made impoundment or any retention of water for storage-and-release operation (Lowenstein and

Panarella, 2018; U.S. Code of Federal Regulations, 2016). It should be noted that some countries have set the maximum SHP capacity much higher; e.g. in India it is 15 MW (Kucukali and Baris 2009), in China it is 25 MW, and in Turkey it is as much as 50 MW (Capi et al., 2012). The lack of compliance on the maximum power of an SHP meant that the European Small Hydropower Association, the European Commission and International Union of Producers and Distributors of Electricity adopted 10 MW as the upper limit of an SHP power back in 2009 (Kucukali and Baris 2009). This study assumes 5 MW as the upper limit of SHP capacity. This is because of the support system for electricity production in place in Poland, as well as the use of this threshold for statistical works in this area.

According to the data of Energy Regulatory Authority, as of December 31, 2020 in Poland there were 767 SHPs with a power less than or equal to 5 MW (including 2 pico hydro with power under 5 kW), and these constituted as much as 98% of the country’s total number of all run-of-river hydropower plants (Energy Regulatory Authority 2021). The total installed capacity in SHPs was 255.5 MW, which is 26.2% of Poland’s total hydropower plant capacity. Of total energy production in Poland, hydropower plants account for only about 2%. Some researchers point to the negligible importance of SHP in the Polish energy system, alongside the unfavourable balance of environmental costs and material benefits associated with their operation (Radtke et al., 2012).

In 2015, the European Union launched an energy strategy setting out principles and goals to increase energy efficiency, to support greener energy sources and to better link national energy markets. Within its framework, the Member States undertook, for example, to increase the share of renewables by at least 32% by 2030 (European Council 2021). Due to the climate crisis and severe environmental degradation processes, in December 2019 the European Commission published Communication - The European Green Deal (European Commission 2012) This is a development strategy to transform the European Union into a climate-neutral, fair and prosperous society with a resource-efficient and competitive economy (Wojtkowska-Łodej, 2021). It stimulates, among other things, the decarbonising of the EU’s energy system. Such a decarbonisation is necessary because more than 75% of greenhouse gas emissions in the European Union come from the use and production of energy (European Commission, 2012). In December 2020, European Union leaders approved the target of reducing greenhouse gas emissions by at least 55% by 2030 compared to 1990 (European Council, 2020). It is indicated that the consequence of climate goals thus formulated will include the need for a review of energy policy legislation and targets (European Council, 2021). As part of the European Green Deal, a European Climate Law was adopted setting in Art. 2 legally binding target of net zero greenhouse gas emission by 2050 (European Commission, 2021; European Parliament, 2021). The need for European Union countries to achieve climate neutrality by 2050 requires a far-reaching transformation of the current energy system into a more efficient integrated energy system in which renewable energy will play an important role (European Council, 2021; European Commission, 2019).

For the reasons given above, a general assessment of SHP issues from the perspective of the European Climate Law (European Parliament, 2021) is justified. Thus, the installations in question are in accordance with Art. 1 of this act, which concerns the gradual reduction of anthropogenic greenhouse gas emissions. Moreover, SHPs are one of the elements conducive to achieving the objective of the European Climate Law, which is climate neutrality (Art. 2). However, when analysing SHP issues in the light of the themes contained in the European Climate Law (whose nature help draw out a concise justification of the basic provisions of the normative part of the law), it can be concluded that SHP is especially realised by:

- Theme 5: by increasing retention and preventing flooding,
- Theme 9: by protecting ecosystem integrity and biodiversity against the threat of climate change,
- Theme 10: by the energy sector (as a sector of the economy) contributing to achieving climate neutrality,
- Theme 11: by switching to energy systems based on renewables,
- Theme 32: by protecting local catchments against extreme climate change effects, as well as preventing damage to ecosystems caused by climate change (droughts, water scarcity, forest fires),
- Theme 38: by stimulating public involvement at all levels to accept and actively participate in climate change efforts. One element in this regard is SHP (European Parliament, 2021).

This article aims to analyse the operation of SHPs in Poland in terms of their potential role in the coming energy transformation that is hailed by the European Union’s adoption of the European Green Deal strategy. The research objective required that the main conditions for the operation of SHP in Poland be considered, especially environmental and legal ones. The literature analysis indicated the existence of a clear gap in the theoretical knowledge relating to this area.

2. MATERIALS AND METHODS

The SHP issues addressed herein were considered in the context of natural and legal conditions. This allowed for a multi-faceted approach to the research problem, and the need for interdisciplinary research. The study was based on the descriptive method and a formal-dogmatic method typical of legal research that consists in examining legal provi-sions. The legal analysis also includes comments of legal comparison. The legal analysis cited legal acts that are significant to the discussed issues. Views expressed in the scien-tific literature are also presented, and existing and planned legislative solutions are as-sessed. Press interviews given by people linked to Poland’s SHP industry played a major role. The considerations are supplemented with statistical data on the operation of SHPs in Poland taken mainly from the Energy Regulatory Authority – a central Polish state administrative body.

3. RESULTS

3.1. Natural and Cultural Conditions for Locating SHPs

Poland has relatively small water resources. This is mainly due to is low sums of precipitation, averaging 600 mm per year nationwide. As a result, in many years, average total surface water resources amount to 61.6 km^3. Due to the terrain, the main direction of water outflow is northwards. As a result, over 95% of water resources flow directly into the Baltic Sea (Gutry-Korycka, 2014). It is worth noting that water resources vary greatly across the country. Runoff coefficients range from 4 dm^3/s/km^2 (the Greater Poland Kuyavia Lakeland) to over 50 dm^3/s/km^2 (mountain areas). The average for the entire country is about 5.5 dm^3/s/km^2 (Jokiel, 2004). Values exceed 8 dm^3/s/km^2 only in the upland area of the Pomeranian Lake District, in the north of the Masurian Lake District (in the north of the country), and in foothill and mountain areas (in the south of the country).

Poland’s river network was shaped mainly in the Quaternary. It is densest in areas where precipitation significantly exceeds evaporation. Such areas exist in the north of the country (the Pomeranian and Masurian Lakelands) and in the south (mountain and foothill areas).

To be effective, hydropower requires appropriate natural conditions. The key requirements are adequate water resources and topography. As already mentioned, Poland essentially has few water resources, which can be considered suitable for SHPs in only in a few regions. The topography is similarly unfavourable. Most of the country is relatively flat lowlands. These two factors put great limitation on where hydropower can be developed in Poland.

Most of Poland’s SHPs are found in the north. Here, the natural conditions (topography, geological structure and precipitation) are the most favourable for locating SHPs. Southern Poland also has much hydropower potential due to its steep terrain differentials in the mountain and foothill areas of the Carpathians and Sudetes. The concentration of SHPs in voivodeships is shown in Figure 1.

Figure 1: The SHP concentration with a power less than or equal to 5 MW in Polish voivodeships

Even in the Middle Ages, hydropower was already being used to power water mills in what is today Poland. About 3,000 such facilities are estimated to have been in operation in the 16th century. With the spread and advancement of technology, the use of hydropower has evolved over the centuries. However, at the beginning of the 20th century, there were about 6,500 plants powered by water engines in Poland (Bajkowski and Górnikowska, 2013). After the Second World War, a socialist system was put in place in Poland that supported only large industrial facilities, including power plants. As a result, the vast majority of SHPs were then shut down and demolished. Only since the 1990s, with the end of the communist era, has there been a slow but systematic reconstruction of SHPs in Poland. Most of the SHPs currently operating are located on the site of a former water mill.

3.2. Legal Conditions for Investments in SHP

Locating SHP facilities requires numerous administrative decisions to be sought. A list of required permits was made by E. Malicka (2018). In Polish law, all hydropower plants, regardless of size or energy-generation method, are considered to be projects with a potentially significant environmental impact (§3, Sect. 1, Pt. 5 of the Regulation of the Council of Ministers of September 10, 2019 on projects that may have a significant environmental impact, Journal of Laws 2019, item 1839). This requires that administrative proceedings be conducted and a decision on environmental conditions – “DEC“ be obtained (Art. 71, Sect. 2, Pt. 2 of the Act of 3 October 2008 on the provision of information on the environment and its protection, public participation in environmental protection and on environmental impact assessments, consolidated text Journal of Laws 2021, item 247 as amended). The DEC plays a particularly important role in the investment process. Its aim is to indicate directions for implementing SHP projects that have minimal negative environmental impact. Although it is not a decision that constitutes sufficient grounds for the SHP investor to proceed with a project, the DEC is required for the issuance of other administrative decisions (e.g. building permit decisions). At the same time, the DEC acts as a “preliminary ruling” with regard to future consent for the project to proceed. The conditions specified in the DEC may not be modified during subsequent project implementation stages, which results from the analysis of court judgments (Filipowicz, 2020).

The procedure for issuing a DEC may also require that an environmental impact assessment – “EIA“ be conducted for the planned SHP. A decision on this matter is issued by an administrative body based on specific criteria. These include, but are not limited to: the size of the SHP, the use of natural resources (water), emissivity and nuisance to the environment, and location (Art. 59, Sect. 1, Pt. 2 and Art. 63 of the Act on the Act of 3 October 2008 on the provision of information on the environment and its protection, public participation in environmental protection and environmental impact assessments). At a later stage, the SHP investor is obliged to prepare and submit another project document: an environmental impact report – “EIR”. This report requires that much data on the environment and the planned SHP be collected. For this reason, the EIR takes a long time to prepare – often more than 12 months (Filipowicz, 2020). In some cases, irrespective of the above-mentioned documents, another document may be required – a water law assessment (Kuśnierkiewicz, 2018; Art. 428 and 437 of the Act of July 20, 2017, Water Law, consolidated text, Journal of Laws of 2021, item 624, as amended). The legal relationship of the EIA to the water law assessment gives priority to the former (Rakoczy, 2018).

The next stage of SHP investment implementation requires that a zoning decision be obtained, unless the location of the planned SHP is covered by a Local Spatial Development Plan "LSDP". This plan contains arrangements regarding the intended use of the land and the distribution of public-purpose investments, as well as specifying development methods and construction conditions (Art. 4 of the Act of 27 March 2003 on spatial planning and development, consolidated text, Journal of Laws of 2022, item 503). The LSDP is adopted by the commune council, but its adoption is not required each time (Plucińska-Filipowicz and Filipowicz, 2018). Hence, when investing in SHP, the requirement to obtain a planning permission should also be considered.

Then, it is necessary to obtain an SHP building permit. This permit is an administrative decision that allows construction (or construction works other than the construction of the building itself) to commence and proceed (Art. 3, Pt. 12 of the Act of July 7, 1994, construction law, consolidated text, Journal of Laws 2021, item 2351 as amended).

Another group of requirements for the implementation of SHP investments relates to obtaining rights to use water and rights to real estate. The waters exploited by the SHP, i.e. natural watercourses or canals, are classified as inland flowing waters (Art. 22, points 1 and 4 of the Water Law). They are excluded from civil law transactions (except in special cases) and are the property of the Public Treasury (Art. 211 and 212 of the Water Law). Similarly, the land beneath inland flowing waters is the property of the Public Treasury and – except in certain cases – is excluded from civil law transactions (Art. 216, Sect. 1 and 2 of the Water Law). Thus, the private SHP investor is not able to acquire ownership of the land and watercourse (or, section thereof) on which the SHP will be located. However, land beneath water for owned by the Public Treasury can be transferred for a fee (Art. 261, Sect. 1, Pt. 1 of the Water Law).

Furthermore, it is imperative that approval for the use of water facilities be obtained. Pursuant to Art. 16, Pt. 65 of the Water Law, these are devices or structures used to shape or exploit water resources. This category includes, among others, damming devices or structures, manmade reservoirs on flowing waters, or hydropower facilities. If the devices required for the SHP investment (e.g. weirs) have already been built and are the property of Public Treasury, they can be rented or leased, among other things (Art. 264 of the Water Law). In other cases, a water permit is required for the construction of water devices.

The water permit is an instrument of water resources management (Art. 11 and 388 of the Water Law). It is a form of administrative decision (Rakoczy, 2018) in which authorised administrative bodies define the permissibility of individual water uses and the conditions for such use. In addition, the document provides for control to ensure that the way the water is used complies with the conditions of the water permit (Sznajder, 2020). Water-law permits are regulatory in nature (Behnke, 2010), and take priority regarding the use of water (Rotko, 2018), including priority (preliminary ruling) with regard to the issuing of other decisions – e.g. a building permit decision. The permit, which covers many different activities related to water use, is not a single decision Rakoczy, 2018).

The role of water permits extends beyond the SHP project implementation itself, and is very significant. Pursuant to Art. 389, Pt. 6, the requirement to obtain them was imposed with particular regard to the following water facilities: hydropower facilities and regulatory damming devices or structures, as well as canals, ditches and man-made reservoirs (located e.g. on rivers). In addition to water devices, water permits are required for: use of water for hydropower, damming, storage or retention of surface waters, and for the exploitation of such waters (Art. 35, Sect. 3 and 389 of the Water Law), as well as water regulation and changes to the relief on land adjacent to water (Art. 389 of the Water Law). Water-law permits are issued for a specified period not exceeding 30 years (Art. 400, Sect. 2 of the Water Law).

In addition to water law permits, Polish law also distinguishes water law notifications. These relate to activities that interfere less with the environment – e.g. the construction of a platform of specific parameters, of drainage devices for buildings, or of specific ponds. Such activities may accompany the location of an SHP facility (Art. 388 and 394, Sect. 1 of the Water Law). If an SHP project requires both a water permit and a water law notification, the application is examined as part of a single procedure, which ends with the issuance of a water permit (Art. 394, Sect. 4 of the Water Law).

The last group of requirements for implementing SHP projects relates to connection to the power grid. This requires that connection conditions be obtained and a contract for connecting to the power grid be concluded. Art. 7 of the Energy Law of April 10, 1997 (consolidated text, Journal of Laws 2021, item 716, as amended) obliges energy companies to conclude an agreement for connection to the power grid. Due to the monopoly that energy companies have on the electricity distribution and transmission market, the legislature made this a public-law obligation (Jankowski, 2020). If an SHP entity applying for connection meets the conditions provided for in Art. 7 of the Energy Law, the energy company is obligated to conclude a grid connection agreement. Moreover, pursuant to Art. 7, sec. 8, Pt. 3.a of this Act, for an SHP of installed electrical capacity not exceeding 5 MW, the fee charged for connection to the network is half actual cost. At this point, it should be clarified that the Polish legislature also employs the terms "micro-installation" and "small installation". Micro-installations include SHPs with a total installed electrical capacity not exceeding 50 kW connected to a power grid with a rated voltage below 110 kV. Meanwhile, a small installation is an SHP with total installed electrical capacity exceeding 50 kW and not more than 1 MW connected to a power grid with a rated voltage below 110 kV (Art. 2, points 18 and 19 of the Act of 20 February 2005 on renewable energy sources, consolidated text Journal of Laws 2021, item 610 as amended). An SHP classified as a micro-installation can be connected to the grid based only on an application submitted to an energy company (Art. 7, Sect. 8d4 of the Energy Law). Moreover, pursuant to Art. 7, Sect. 8, Pt. 3.b of the Energy Law, for micro-installations no fee is charged for connection to the electricity distribution network.

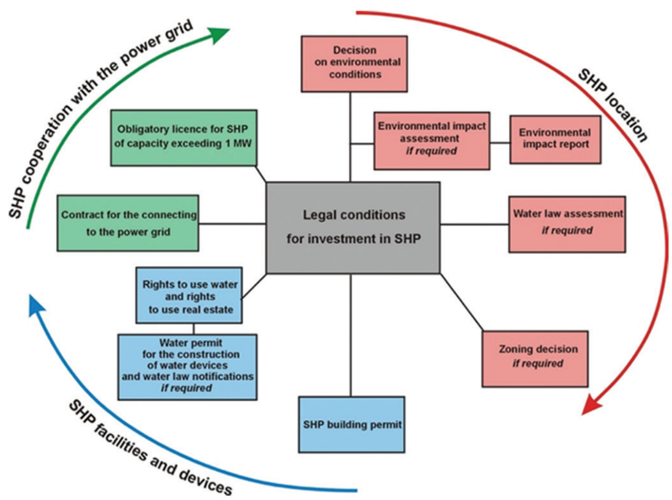
Finally, it should be noted that no license is required to conduct economic activity using an SHP classified as a micro- or small installation (Art. 32., Sect. 1, Pt. 1.c of the Energy Law). On the other hand, energy generation using an SHP of capacity exceeding 1 MW, and thus above the limit for a small installation, requires a license. The obtaining of a license is a condition for commencing operations and results in the licensee being subject to supervision by the President of the Energy Regulatory Office (Będkowski-Kozioł, 2020). A simplified representation of the above-described legal conditions for investment in SHP is given in Figure 2.

Measures facilitating connection to the grid and the absence of a distribution-grid connection fee for micro-installations are intended to encourage the start-up and functioning of such installations. This is a good solution to help households and small enterprises to use hydropower for the sake of the environment.

Running an SHP electricity-generation business (i.e. a small installation) is a regulated activity and requires an entry in the register of small-installation energy producers (Art. 7 of the Act on Renewable Energy Sources). Conversely, SHP energy generation by a natural person not recognised as an entrepreneur and the sale of such energy are not considered an economic activity.

SHP start-up costs vary greatly. This is due to the multiplicity of local, national, environmental (e.g. reservoir size, ecological condition, size of water flow) and infrastructure conditions. These include especially: land rights, fees for essential permits, fees for preparing relevant documents, real-estate costs, hydraulic engineering works, technical infrastructure and employee remuneration. In Poland, these usually total from around 100,000 to several million euros. Only pico hydro has lower costs. In each case, input rates translate into output rates (revenue), as greater financial investments allow for greater energy production.

Figure 2: Legal conditions for investment in SHP



However, this energy generally sells at below market price and therefore requires state support. The support system is mentioned in section 3.5.

3.3. Environmental Aspects of SHP Operation

The construction of hydropower facilities on rivers always has an impact on the aquatic ecosystem. The impact that an SHP can have will vary considerably depending on the facility. The individual characteristics of the river, its physical and ecological state, including species and types of habitats that will lie within the power plant's range of influence, will also be important. These factors require that the impact of each power plant should be analysed individually.

An SHP has an impact on the natural ecosystem at every stage of the hydropower plant's lifetime. The construction, operation and decommissioning of the power plant will differ in the extent of their effects on the environment, and especially on the river ecosystem. Despite the individual nature of the SHP's ecosystem impact, there are a few features that are usually observed. One is any change in river bed morphology. These can disturb existing hydrological and hydromorphological processes. Downstream of a damming structure, bottom erosion will accelerate. Directly related to this, the sediment displacement process will be disturbed, with sediments starting to accumulate above the damming. Sedimentation can create various habitats directly and indirectly providing space for numerous species. Creating a barrier to the river's current in the form of a dam or weir disrupts natural sediment dynamics. Sediments accumulating in front of the dam may negatively impact plant and animal species, disturbing their existing habitats. Another important factor is the variation in velocity rate. Too little velocity may result in fish spawning grounds drying out and prevent the growth of young specimens. It may also hamper the upstream migration of fish due to reduced velocity and/or a physical obstacle that the fish will not be able to overcome. Reducing the velocity of water in a river may cause it to warm more quickly and reduce its oxygen saturation.

The damming of water also significantly shapes hydrogeological conditions. Above a dam, the water table will rise. Additionally, if there are frequent fluctuations in the level of damming during SHP operation, there will also be fluctuations in groundwater. This may result in biocenotic changes.

The ill-thought-through location of an SHP may also contribute to economic losses. Above the dam, floodwater flow conditions will change (Przedwojski et. al., 2007) which may result in inundation or flooding.

These examples of changes that SHP may cause on the natural ecosystem do not constitute an exhaustive list. Other consequences are referred to in the literature, such as:

- Intensification of the channel overgrowing, increasing channel roughness and water flow resistance,
- Changes in the species composition of aquatic vegetation,
- Disruption of the natural state–flow relationship (Wierzbicki 2008),
- An artificial step increases piezometric pressure and intensifies filtration within the physical structure,

- Erosion may lower the water table below a dam (Bojarski et. al., 2005),
- Changes and depletion of flora along sections of rivers dammed by an SHP (Jansson, 2002),
- A decrease in the number of invertebrate taxa (Growns and Growns, 2001),
- Change in birdlife species distribution.

It should be noted each of these is conditioned by both anthropogenic factors (choice of SHP technology and construction, especially fish ladders; the servicing of the SHP; and its method of exploitation) and the specific natural conditions of each aquatic ecosystem.

3.4. Legal Aspects of SHP Operation

The operation of an SHP is based on using water for electricity production. This requires the payment of water services consisting in the returnable abstraction of water. With regard to water services, the above-mentioned water permit is also required (Art. 389, Pt. 1 of the Water Law). According to the current Polish water policy, fees for water services are an economic instrument of water management (Art. 267, Pt. 1 of the Water Law). Pursuant to Art. 270, Sect. 4 of the Water Law, the fee for the abstraction of water for hydropower plants is charged only for the amount of electricity that the hydropower facility generates using returnable water. This is understood as water that is abstracted, used and then discharged in the same quantity and of undeteriorated quality, as well as water abstracted non-returnably that is not intended for electricity generation. The fees are: EUR 0.27 per MWh of electricity generated and EUR 0.077 for non-returnable consumption of 1 m^3 of process water (Art. 274, Pt. 3.a of the Water Law). In this aspect, the Polish legislature removed doubts that had arisen regarding the possibility of hydropower plants incurring an additional, "flat" fee. It is independent of the variable fee, which includes the above-mentioned fees for the amount of energy produced and process water abstracted (Robakowska, 2018).

The functioning of an SHP – like any other activity – entails the need to pay fees for the rights to the real estate and movables that make up the entirety of the business. Among the other costs, it is worth mentioning insurance. In Poland, no bespoke insurance products are available for SHPs. They constitute a particularly advanced form of insurance protection, being those most suited to the risks incurred. On the Polish insurance market, it is possible to join a group property insurance programme devised for SHP owners (Koropis, 2013). Additionally, non-obvious costs should be considered such as the management of waste not coming from the SHP operator that collect on the grates of the facility having been carried on the watercourse's current, as results from the applicable legal regulations (Wróblewska, 2013).

3.5. The System of Support for SHPs

Poland's existing SHP support systems are divided into three categories. This division also reflects the evolution of legal solutions adopted to optimise support for electricity production from renewable sources (Malicka, 2018).

The first category of support, in force since 2005, was based on a system of certificates of origin – "CO" of RES electricity generation. Such a certificate confirms that the energy it covers has been generated from renewable energy sources (Art. 44, Sect. 1 of the Act on Renewable Energy Sources). Due to the lack of a statutory definition, a CO is defined in legal science as a carrier of specific property rights, and thus having a certain economic value that varies depending on the supply and demand for certificates of origin within a given period. It is defined as a quasi-security (Przybojewska, 2020). The property rights pertaining to a CO are transferable and constitute a commodity. They are first created when the CO is entered on the recording account in the certificate of origin register (Art. 63 of the Act on Renewable Energy Sources). The number of property rights corresponds to the amount of energy shown in the CO, while the nominal value of one property right corresponds to 1 kWh of electricity (District Court in Warsaw, 2019; Trela and Dubiel, 2017).

The property rights created as a result of CO registration are commonly referred to as a Tradable Green Certificate – "TGC". TGCs are purchased by entities that have been obliged by the legislature to obtain and submit for redemption a certain number of COs from renewable energy sources (including energy companies and industrial customers). Failure to meet the requirement to obtain a TGC results in the need to pay a substitution fee (Trela and Dubiel, 2017; Art. 52 and 59 of the Act on Renewable Energy Sources). A system constructed in this way, consisting in the imposition of an obligation on relevant entities to purchase and submit for redemption a CO, is designed to support SHP electricity producers, providing them with a secondary, autonomous income from the sale of certificates of origin. The producer's primary income is the sale of generated energy (Supreme Administrative Court, 2011). In addition, for an SHP of capacity below 500 kW, the legislature guaranteed energy producers 15 years of energy sales by imposing on certain entities the obligation to purchase said energy at the average selling price of electricity on the competitive market in the previous quarter, as announced by the President of Energy Regulatory Office (Przybylska, 2018; Przybylska-Cząstkiewicz, 2017; Art. 23, Sect. 2, Pt. 18.a of the Energy Law, Art. 41, 42 and 43, Sect. 1 of the Act on Renewable Energy Sources).

Article 44, Sect. 11 of the Act on Renewable Energy Sources shows that a CO is due only in the case of SHPs whose power does not exceed 5 MW. Hence, SHPs with a total installed capacity of more than 5 MW cannot benefit from this form of support. Furthermore, currently, only some producers are entitled to a CO: producers who are entrepreneurs generating energy in a micro-installation SHP (if the micro-installation first generated energy before July 1, 2016) and electricity producers in other SHPs not exceeding 5 MW capacity (if the energy was first generated there before 1 July 2016). Finally, it should be noted that the entitlement to a CO only pertains for the 15 years following the initial date of energy generation (Art. 44, Sect. 1 and 5 of the Act on Renewable Energy Sources). The time frame of this support system is set to run concurrently with the aforementioned 15-year obligation to purchase electricity (Szambelańczyk, 2016).

The CO employed in the support system should be distinguished from other documents – the guarantee of origin for RES electricity. Guarantees of origin only certify to the end-user the environmental value resulting from the avoidance of greenhouse gas emissions and that the amount of electricity they injected into the distribution network or transmission network was generated from RES in renewable energy installations. No property rights arise from guarantees of origin, and their sale is independent of the trading in property rights that result from a CO (Art. 120 of the Act on Renewable Energy Sources). Like TGCs, they are marketable, but do not noticeably increase the RES-energy use (Przybojowska, 2020). Their real value is created by any "green policy" that a company might have to demonstrate to society that they are using green energy (Szambelańczyk, 2016).

In light of this, the Polish legislature distinguishes two documents that have been assigned entirely different functions. The first is a guarantee of origin, which has an informational value to the end-recipient as to whether and to what extent the energy received was produced from renewable sources. The second is a CO, which plays a key role in a demand-driven support system that specifies standards relating to what share of energy comes from renewable sources (Przybojowska, 2020).

The second category of support for SHP energy producers is based on an auction system. This system was introduced into the Polish legal system in 2015 under the Act on Renewable Energy Sources. The reform of the support system created a dichotomous model. On the one hand, support provided by the CO was maintained, while the auction system, which had not previously been in force, was added. Such procedures as that aimed at concluding contracts for the sale of SHP-generated electricity are conducted in accordance with specific rules provided for in the Act on Renewable Energy Sources (Przybylska, 2018). In the auction, participants compete for public aid (support) consisting in: the conclusion of an electricity sale agreement with an entity obligated to purchase (for SHPs with total installed capacity below 500 kW) or the granting of a negative balance coverage guarantee (Pokrzywniak, 2016; Muszyński, 2020).

"Old" SHP energy producers (those generating energy since before 1 July 2016) were left the choice of whether to use CO support or switch to the auction system. In turn, "new" SHP energy producers (those generating energy since July 1, 2016) must participate in auctions if they wish to use support. This relationship between the support systems means that the CO-based system is gradually being phased out by the Polish legislature in favour of the auction system (Przybojewska, 2020). For the "old" generators, the requirements for joining an auction were simplified, being limited to the requirement to submit a declaration. By contrast, "new generators" are subject to formal assessment of whether they meet legal conditions for admission to an auction and must obtain a certificate of admission to the auction (Przybylska, 2018; Pokrzywniak, 2016; Art. 44, 71, 75 and 76 of the Act on Renewable Energy Sources). The period of support granted on winning an auction shall not exceed 15 years from the date of first generation of energy by the SHP as confirmed by CO release, or from the date of sale of electricity after the auction is closed (Art. 77, Sect. 1 of the Act on Renewable Energy Sources).

Article 73, Sect. 1 of the Act on Renewable Energy Sources provides that auctions must be held at least once a year. Auctions for different categories of RES installations are conducted separately. These categories are determined based on technology used ("technology mixes"). Thus, one shared technology mix is relevant for SHP, and consists of: facilities using only hydropower to generate electricity: of capacity below 500 kW, of capacity not <500 kW and exceeding 1 MW, and of capacity exceeding 1 MW; facilities using bioliquids; and facilities using geothermal energy. Within each technological basket, the legislator also introduced the obligation to conduct separate auctions for facilities of capacity not exceeding 1 MW and separate auctions for facilities of capacity exceeding 1 MW (Art. 73, Sect. 3a and 4 of the Act on Renewable Energy Sources).

The SHP energy producer submits a bid using an online form. The bid should include the total amount of electricity (in MWh) and the price (in PLN) for which the generator undertakes to sell energy under the auction in the specified bid period. It is also required to indicate the planned start date for the period in which the auction support scheme and the period of this support will be used (Art. 79, Sect. 1 and 3 of the Act on Renewable Energy Sources). The price offered by the SHP producer may not exceed a "reference price", which can be offered in the call for bids for a given technology mix in accordance with the relevant regulation (Art. 77, Sect. 3 of the Act on Renewable Energy Sources). Pursuant to Art. 80, Sect. 1, Pt. 1 of the Act on Renewable Energy Sources, the auction is won by the participants who offer the lowest electricity selling price. Pursuant to Art. 79, Sect. 6 of the Act on Renewable Energy Sources, a bid submitted by an auction participant is not available to competing participants. Hence, it is not possible to decide to lower a previously offered price. In this regard, auctions are thus similar to tender procedures (Muszyński, 2020).

Failure to produce at least 85% of the amount of electricity declared in the bid within the three-year settlement period is subject to a penalty. Penalties do not apply in the event of specific circumstances – e.g. a change in the hydrological flow that exceeds 25% of the average long-term flow in at least one of the verified years or a technical failure of SHP constituting damage or destruction of the SHP, objects or devices determining the operation SHP that is sudden, unforeseen, and not dependent on the producer (Art. 168, Sect. 15 of the Act on Renewable Energy Sources).

The third category of SHP producer support is valid in Poland since 2018. The new system introduced instruments based on a fixed purchase price as an alternative to the previous support systems, i.e. the CO and auctions. The choice of support scheme is left to the generators, with each SHP being allowed to use only one support instrument. The essence of fixed-purchase-price instruments is the possibility for the preferential sale of unused electricity fed into the distribution network (Trupkiewicz, 2020). Such instruments include: the feed-in tariff system – "FIT" and the feed-in premium system – "FIP". The choice between them depends primarily on the power of the SHP.

Based on Art. 70a, Sect. 1 of the Act on Renewable Energy Sources, an energy producer with an SHP of less than 500 kW may sell unused electricity introduced to the grid at a fixed purchase price to an obligated entity or one of his or her own choosing. In such an approach, FIT grants the energy producer the right to conclude an electricity sale agreement with an obligated entity. The obliged entity is designated by the competent administrative authority. That entity has a public-law obligation to directly purchase a certain amount of electricity produced by a given SHP at a fixed purchase price (established by administrative process). This structure of the system means that the FIT support (state aid) is transferred to the producer under the contract concluded with the obligated entity, as it is included in the fixed purchase price (Trupkiewicz, 2020; Art. 70c of the Act on Renewable Energy Sources).

An electricity producer with an SHP of less than 500 kW may use the FIP system instead of the FIT system. In such a case, no contract whose content is determined by the FIT instrument is concluded with an obligated entity, and the purchase of energy by the obligated entity is not guaranteed. Instead of such a contract, the producer concludes an electricity sale agreement with an entity he has found and selected at market prices on a competitive electricity market. Then, the support under the FIP system consists in the producer being granted the right to coverage of a negative balance of selling price to feed-in tariff level. The design of the FIT and FIP instruments in relation to energy producers with SHPs of less than 500 kW provides producers a choice: to use the FIT or FIP system (Trupkiewicz, 2020; Art. 70a, 70c, Sect. 6 of the Act on Renewable Energy Sources).

The system of supporting electricity producers with SHPs of not less than 500 kW and not more than 2.5 MW is different. Such entities are eligible for FIP support only. Consequently, by selling electricity at market prices, they are also entitled to negative balance coverage (Art. 70a, Sect. 2, 2a and 3 of the Act on Renewable Energy Sources).

Support under the FIT and FIP systems is based on a fixed-purchase-price parameter. The fixed purchase price is the price of electricity at which an obligated entity purchases from an energy producer using FIT support, or the base price for calculating a negative balance for producers using FIP support (Art. 2, Pt. 33b of the Act on Renewable Energy Sources). Thus, for an SHP of less than 500 kW, the fixed purchase price is 95% of the reference price, and for an SHP of not less than 500 kW and not more than 2.5 MW the fixed purchase price is 90% of the reference price (Art. 70e of the Act on Renewable Energy Sources). The price of hydropower depends on the SHP capacity, and in 2021 is EUR 141.07 for <500 kW, EUR 126.74 for 500 kW to 1MW and EUR 121.23 for power >1 MW (§2, Sect. 1 of the Regulation of the Minister of Climate and Environment of April 16, 2021, Journal of Laws 2021, item 722).

Pursuant to Art. 70f of the Act on Renewable Energy Sources, both the obligation to purchase unused electricity under the FIT and the right to negative balance coverage under the FIP arises on the first day of sale of electricity covered by the support scheme and lasts for the next 15 years. Meanwhile, for SHPs that have benefited from CO support and changed system to FIT or FIP, the support period is counted from the first day of electricity generation confirmed by the issued CO. In this case, it is deemed that there is a continuation of support, because the total period that an SHP is covered by support in the CO system and support in the FIT or FIP system may not exceed a maximum of 15 years (Trupkiewicz, 2020). This confirms the rule that state aid for an SHP is granted for a maximum period of 15 years. During this period, however, changes of support system are allowed.

3.6. Legal Conditions for SHP Investments and Operation – Selected Remarks on the Example of European Countries

The length of administrative procedure required for the investments in SHP in Poland, ranging from at least 1 to about 5 years, is no exception in comparison to other European countries. In accordance with conducted research, obtaining the necessary permits (apart from the length of building SHP instalation itself) may last: from 4 to 11 years in France, about 7 years in Greece, from 1,5 to 7 years in Italy or <2 years in Sweden (RESTOR HYDRO, 2014).

The key role in the location of planned SHP is obtaining obligatory decisions in the field of environmental protection. For example, in Belgium (Flanders, Wallonia) and Greece it is necessary to procure an environmental impact decision. In Italy, Slovenia and Slovakia an environmental impact assessment shall be obtained. The requirements for the impact assessment of the planned SHP on the environment may, however, differ due to installed power by being less restrictive in the case of small installations. The construction of rights to use water for hydropower purposes results from the water and land management system adopted in the law of each country. For instance, in Belgium (Flanders, Wallonia) there are differences resulting from the classification of waterways which depending on SHP location results in the need to obtain a water collection permit and/or consent to modify a watercourse. In Greece, a water use permit shall be obtained, in Italy – a water use license while in Lithuania an investor should procure a permit for special water use (RESTOR HYDRO, 2014).

In European countries the use of the same SHP support can also be noticed. Thus, in Belgium, Romania and Sweden support is based on TGCs. On the other hand, in Germany, Greece, France, Italy, the Czech Republic and Lithuania the support is distributed through FIT and FIP tariffs. In Denmark, Portugal, Slovakia and Slovenia, support is provided only under the form of FIT tariffs. Depending on the country, support periods range from 10 to 30 years, but – for example in Denmark – there is no time limit (European Small Hydropower Association, 2022; Council of European Energy Regulators, 2021).

The above remarks allow to conclude that the legal regulations in general aspects concerning the establishment and operation of SHP is similar in European countries. The differences reveal especially in more detailed issues which reflect the state policy (such as the duration of the support systems) or in the integration of the conditions for the location and operation of the SHP into the applicable institutions and legal acts.

4. SOCIAL CONFLICTS, ENVIRONMENTAL LOSSES AND PROBLEMS RESULTING FROM ERRORS IN THE MANAGEMENT OF SHP AND THE LACK OF OPTIMAL LEGAL REGULATION: CASE STUDIES

4.1. Case Study 1

This case study concerns a 44-kW SHP on the Niechwaszcz watercourse, 3.7 km upstream of its confluence with the Wda river in northern Poland. In July 2020, downstream of the SHP, there was a mass die-off of fish and water pollution, caused in part by a high concentration of suspended matter. The results of a water quality inspection by the environmental protection services showed a rapid increase in total phosphorus and total nitrogen in both rivers, with concentrations reaching 2.26±0.27 mg/dm^3 and 9.6 mg/dm^3, respectively. Furthermore, high suspended matter content (360±83 mg/dm^3) and a mass die-off of fish was found in the Niechwaszcz watercourse, downstream of the SHP and in the Wda river. The fish died from their gills being blocked by suspended matter. The heavy pollution of the rivers was caused by the rapid discharge (discharge) of water from the SHP reservoir, which caused sediments accumulated in it to be drained off. The draining of the reservoir had been necessitated by the obligation on the SHP owner to renovate a bridge on a public road running through the SHP. The rapid discharge (dumping) of water from the reservoir resulted from the need to complete the repair of the bridge in just 1.5 months in order not to impede the spawning of fish species. The renovation date thus appears to have been selected with due care. Analysis of numerous documents that the SHP owner received three years earlier when buying the SHP revealed no information on the volume of sediment in the tank, nor recommendations on how to periodically drain it.

This example shows that, despite the costly and extensive documentation required for SHP, it lacks a lot of relevant data and guidance. Moreover, the obligation on owners to carry out repairs to bridges and roads through the SHP is also questionable, given that they do not necessarily have adequate experience in such works. As a result, a conflict arose between the owner of the SHP and the local community, pro-ecological organisations, environmental protection services and the manager of surface waters, despite the owner of the SHP having undertaken to cover any losses to the fish life in both rivers. Conflicts of this kind are not conducive to public support for developing SHPs.

4.2. Case Study 2

An SHP was established at the site of a former water mill on the Warta River in Karcze-wice (central Poland) in the late 1990s. Water flows to the SHP through a man-made mill chute (Młynówka), which begins at km 702.9 of the river and rejoins it at km 701.5. Ini-tially, about 50% of the Warta River's water flowed through this canal, and the rest flowed along its natural historical channel. In the vicinity of both watercourses there are areas classified flood-risk areas. Presented case is shown in Figure 3.

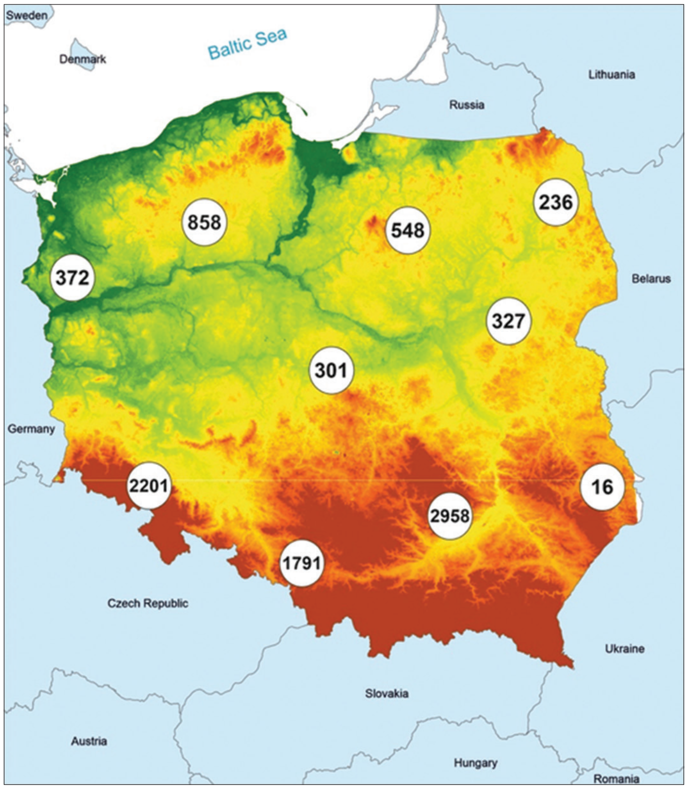
Figure 3: Location of SHP Karczewice on the background of the flood-hazard area

Explanations: 1 – rivers and canals; 2 – flood zones (up to 0.5 m); 3 – flood zones (up to 2.0 m), 4 – river kilometere to mouth; 5 – SHP; 6 – stone threshold; 7 – forests and bushes; 8 – meadows and arable land; 9 – dispersed building develompment; 10 – main roads. Prepared on the basis of Informatic System for Country Protection – Flood Hazard Map, https://isok.gov.pl/hydroportal.html.

In SHP Karczewice, two turbine sets were installed that required a velocity of 3.5 m^3/s, i.e. almost double the needs of the historical mill. The damming level was also raised by about 0.5 m. Moreover, droughts began to increase in frequency as a result of global warming. To increase the water volume in the chute, a stone threshold was built in the Warta River without the required permit. This significantly reduced the velocity in the natural section of the river to approx. 1.2 m^3/s. The river bed was exposed, and locals became unable to bathe or fish. In turn, during high water levels, due to the increased damming of water by the SHP, real-estate was flooded that had not previously been af-fected during floods. Public protests began that lasted for several years, resulting in 2016 in the competent administrative authority refusing to issue a water permit for special use of the Warta River's waters by the SHP.

Despite this, the SHP continued to function, arguing from the standpoint of ful-filling its contractual obligation to the energy recipient. In 2020, after more than four years of documentation being sent back and forth between multiple offices and the SHP owner, the competent administrative authority anulled the 2016 decision and granted a permit for the operation of the SHP. A permit was also granted for the additional damming of the

AQ2 **Figure 4:** Potential sites for the construction of an SHP in Poland according to RESTOR



Warta River with the above-mentioned stone threshold fixing the damming level (at 219.29 m a.s.l.) and maintaining 2.37 m^3/s of uninterrupted velocity in the natural river channel. However, it does not seem that the parameters indicated in the above permit can be fully met. The water velocity volume into the SHP will be sufficient during high flows and medium flows (7.4 m^3/s) in the Warta, even after deducting the required minimum velocity (2.37 m^3/s) that must be maintained in the natural section of the river. However, during low flows (below 3 m^3/s), flow to the SHP via the mill chute cannot be maintained in the expected amount while also maintaining the required minimum velocity in the natural river bed. This observation is significant, all the more so given that low water levels and low river flows have been prolonged in this part of Europe for well over a decade (Tomaszewski and Kozek, 2021; Kozek and Tomaszewski, 2021; Feyen and Dankers, 2009). However, the SHP raising the damming level will pose an additional threat to the population.

This example shows the negative effects of a lack of precision in decisions when commissioning SHPs and failure to consider the true hydropower potential of a river. The resulting problems have been made particularly visible by ongoing climate warming and the reduction in water resources and increase in extreme hydrological events (droughts, floods). Meanwhile, already in the 20th century, it was known that water levels and velocity in the section of the Warta River in question fluctuated greatly, with velocity ranging from 2.6 to 39 m^3/s. Thus, a lack of precision in assessing natural conditions causes many administrative and legal complications, as well as contributing to a local public dissatisfaction and lack of acceptance of such projects.

4.3. Case Study 3

This example does not apply to a specific installation, but illustrates a systemic difficulty for SHPs that are or might be located in a Natura2000 site – e.g. in a natural park buffer zone. Natura2000 is a network of areas within the European Union where nature is subject to protection. The aim of the Natura2000 programme is to preserve natural habitat types and species considered valuable and endangered on a European scale, in accordance with Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds and Council Directive 92/43/EEC of 21 May on the conservation of natural habitats of wild fauna and flora. The difficulty in question consists in the refusal to issue a decision for the construction or renovation and modernisation of SHP as part of the procedure - discussed in part 3.2. – for issuing a DEC. As a consequence, an investor's ability to obtain a DEC is significantly impeded or even excluded.

At the same time, however, from a legal standpoint, the problem is not complicated. In the SHP industry, it is indicated that it would be sufficient to amend the real-estate management act (consolidated text, Journal of Laws 2021, item 1899) by qualifying – as a public goal within the meaning of this act – activities consisting in modernising existing RES installations using the hydro energy of rivers or constructing new ones. In conjunction with other legal provisions, a change in this respect would facilitate the development of SHP in Poland. Unfortunately, despite such a postulate having been submitted to the legislator several years ago, it has not been processed.

5. DISCUSSION

Despite conditions for the construction of SHPs being unfavourable in most of Poland, there are still convenient locations for such facilities in the country. According to Renewable Energy Sources Transforming Our Regions (RESTOR) Hydro (2021), an EU-funded project, there are over 8,000 potential sites for the construction of an SHP in Poland (Figure 4). The project aims to increase energy production from micro and small hydro by identifying and restoring currently inoperative mills and other historical sites and also promotes the cultural heritage. RESTOR indicates that the area of greatest potential is the south and south-west of the country. Simultaneously modern SHP technologies provide additional optimism as to the warrantedness of building an SHP in Poland. They allow even small water drops to be used for energy production (Drzewiecki, 2011). This is extremely important, considering the topography of Poland mentioned earlier. It is worth noting that a small hydropower plant can operate in a hybrid system with, for example, photovoltaics.

The construction and operation of an SHP will always be associated with an impact on animate and inanimate nature. So too is the structure and operation of any anthropogenic facility. However, relevant provisions regulate in detail the functioning of an SHP, and define the conditions to be met for an SHP to be established in a given location. Meeting all these requirements minimises the negative consequences associated with the construction and operation of the SHP. The link between SHP activity and nature is extremely complex. Many changes in natural ecosystems that stem from an SHP may be long-term and spatially far-reaching. Therefore, it is extremely important to properly manage SHPs through appropriate water management. This should take into account not only energy production, but above all the possibility of negative phenomena associated with the operation of the SHP.

It should be emphasised that, in many cases, SHPs are set up in places that have already been transformed by humans building water mills, sawmills, etc. (Radtke et al., 2012). These facilities' operation also involved damming a river and building a reservoir. Therefore, locating an SHP in their stead should not be equated with the locating of entirely new facilities that will transform the aquatic ecosystem. The construction of small hydropower plants is usually socially accepted, and only extremely rarely provokes protests. This is because this form of energy is widely recognised to be safe and ecological. A small hydroelectric power plant also has a positive effect on the landscape, enriching and diversifying the local area.

Due to the nature of the SHP, the support systems based on feed-in tariffs (FIT) and market price subsidies (FIP) are particularly important. They are optimal for small-scale electricity producers, which is reflected in the positive opinions of them on the part of entities operating SHPs. From this perspective, the role played by the other two systems is not so important. In the case of the system based on TGCs, there is an oversupply that translates into a low market price (Malicka, 2018). Furthermore, until the end of 2009, the sale of property rights from TGCs was taxed separately as autonomous income from cash capitals and was not included in the income from the sale of renewable energy produced, which is classified as income from non-agricultural, SHP business activities. This state of affairs was unfavourable for taxpayers gaining revenue from the sale of TGCs (Pasiewicz and Brysz, 2013). On the other hand, the auction system is highly formalised and, consequently, its lack of flexibility does not necessarily allow it to correspond to the specificity of the SHP.

Over the course of 2020 and 2021, the subject of SHP again became a subject of interest to the legislature and energy producers. This is because the aforementioned 15-year period of combined SHP support was closing for about 400 hydroelectric power plants (The Parliament of the Republic of Poland, 2021). A lack of public-sector operational support via appropriate legal regulations makes SHP dependent for its existence on selling the energy it produces on the wholesale market. The prices there do not ensure the profitability of SHP operations (Chojnacki 2021). Consequently, many SHPs may close. This fact led to an amendment of the Act on Renewable Energy Sources in September 2021. The support period was extended from 15 to 17 years, but only within the FIT and FIP systems (provisions entered into force on October 30, 2021). This extension of support applies to SHPs not exceeding 1 MW, however. SHP energy producers with a capacity of no more than 1 MW who lost support during the drafting of the amendment have the right to apply for coverage of the negative balance on energy they generated and sold during the "transitional period" (Art. 11, Sect. 6 of the Act of 17 September 2021 amending the act on Renewable Energy Sources and certain other acts, Journal of Laws 2021, item 1873).

When making the two-year extension, the Polish legislature was guided by an intention to temporarily reduce the risk of some SHP being terminated by an absence of support. At the same time, the legislature assumes that an operational support system in the form of guaranteed bonuses will be adopted and announced in the meantime, including for SHPs whose support period has expired and whose operating costs make it impossible to operate on the basis of wholesale market energy prices (The Parliament of the Republic of Poland, 2021). The legislator is aware that the operating costs for SHPs are significantly higher than for, for example, producers of photovoltaic energy. This is due not only to technological issues, but also to the costs associated with water and environmental management (The Parliament of the Republic of Poland, 2021). Legislative solutions regarding support under the FIT and FIP systems reflect the SHP industry's assertions that they constitute a "life line" for hundreds of SHPs.

The legal framework for SHP functioning in Poland can be divided into two separate areas being evaluated. The first concerns the great complexity of facility location and operation conditions for SHPs. This is due to the nature of SHPs and their close integration with the (mainly aquatic) environment. At the same time, water management is a particularly sensitive area that is influenced not only by the Polish legislature, but also by the EU legislature. Hence, on the one hand, we should strive for proper water management, especially water protection, and, on the other, to facilitate the location and operation of SHP in all feasible areas. It is very important to ensure a balance between these two areas using stable, "friendly" legal conditions. Meanwhile, in evaluating the SHP support systems, it should be stated that they are evolving in the right direction. The legislature has gradually adopted new solutions, creating alternatives for entities operating SHPs and ultimately developing the FIT and FIP system, which largely meets their needs. However, this has taken many years. It seems, however, that further changes will be desirable with time. Work on the targeted support system for SHP is of particular importance given EU Member States' obligation to gradually increase the production of electricity from renewable sources.

In March 2021, the Polish government adopted a resolution on Poland's energy policy until 2040. The document contains a vision of Poland's energy transformation strategy, including the selection of technologies to build a low-emission energy system. The document largely ignored the role and importance of small hydropower plants. According to the presented analyses and forecasts, the volume of net electricity production from hydropower (mainly large hydropower plants) will not change up until 2040. It will be around 1.8 TWh per year. This is confirmed by the lack of funds allocated to investment outlays for expanding the generation capacity of hydroelectric power plants. According to the adopted strategy, the main thrust of investment in renewable energy is to be towards wind (onshore and offshore) and solar energy. These forms of energy are planned to receive, respectively: EUR 35.6 billion and EUR 6.3 billion.

In Poland, the current high use of fossil fuels makes the implementation of the climate neutrality goal by 2050 particularly difficult. This is because of the extremely high costs of energy transformation that the country will have to bear in a relatively short time. The document defining Poland's energy policy until 2040 indicates a systematic shift from fossil-fuel energy to nuclear and wind energy. However, heavy socio-economic pressure, especially in coal-mining regions, may make it difficult to achieve the goals set. Projected expenditure on energy-transformation investments in Poland totals EUR 355 billion for 2021–40 – from an annual national budget of approximately EUR 111 billion. Therefore, key to achieving climate neutrality goals is EU financial support.

Bearing in mind Poland's existing electricity production being based on coal and the obligations stemming from the European Green Deal, it should be concluded that changes in the structure of energy production sources in the country will increasingly move towards renewable sources over the next few decades. Of these sources, small hydropower engineering, which is by definition an expression of private initiatives, deserves special attention. Providing steady electricity generation, it is not as heavily dependent on weather conditions as are wind or solar energy. At the same time, it is starting to be noticeably influenced by progressive global warming, which is reducing Poland's water resources. In general however, investing in a small hydropower plant is more complicated than investing in certain other renewable energy installations. Although the Polish legal environment creates a similar framework for all renewable energy installations and is not more amenable to other methods of producing green energy, SHP has special location considerations. There is a noticeable difference in ease of locating a photovoltaic installation or small wind turbine on land owned by a private individual. SHPs must be integrated into specific water–environment relations and usually require a more complex infrastructure. Additionally, a private entity running an SHP will never own the waters, nor the land beneath them, as these are the property of the State Treasury. Therefore, because SHP is associated with public waters and land, it is – from the private owner's perspective –more difficult to perceive them as a coherent economic unity dependent solely on the owner.

The data presented and analysis carried out herein clearly indicate the need to introduce changes to the functioning of SHP in Poland. These changes must be complementary in terms of legal and environmental solutions. Recommendations in the form of final guidelines are presented below. They implementation should, according to the authors, bring about positive changes and help increase the significance of SHP in Poland.

1. To increase the awareness of the general public and local authorities with regard to the importance of SHP in shaping the water resources of a catchment area (slowing runoff, increasing the water resources of the catchment area). Highlighting this aspect is extremely important in the face of climate change and water scarcity problems in some parts of the country.
2. Reviewing Poland's strategy for its hydroenergy policy until 2040 in accordance with European Climate Law.
3. Providing the possibility of obtaining financing to build SHP under programmes promoting small water retention. This applies especially to areas of water deficits – such as the Wielkopolska-Kujawskie Lakeland.
4. Stimulating local communities and private investors to construction of new SHPs through additional financial support and friendly legal environment.
5. Simplifying – at every possible step – the legal procedure for obtaining approval for building SHPs by creating fast legal paths dedicated to SHP. Such a procedure should be significantly accelerated in the light of European Climate Law commitments. This remark concerns especially locations where an installation of the same or similar nature (water sawmill, water mill) existed in the past.
6. Developing a stable and predictable support system targeted at SHP that encourages investments in SHPs through ensure the economic profitability of such projects. It can be achieved by FIT and FIP support system which is not limited in time. This proposition however, does not exclude the possibility of a partially reduction of the support after the depreciation of the SHP facility investment.
7. Conducting widespread activities to achieve universal public acceptance of the energy transformation from coal energy to green energy.

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