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## The effect of legislation on hydropower development: case study of Lithuania

### Abstract

The article analyzes the effect of the Lithuanian legislation on hydropower development via the document content analysis and comparative analysis of legislation and scientific literature. The main focus of the article is on assessing the hydropower potential in line with the environmental legislation and establishing the possible development priorities. Effective legislative activity and energy sector management stimulate the production and consumption of electricity from renewable energy (RE) sources, which serve as an alternative to organic fuel, while in Lithuania, non-harmonized legislation creates barriers for effective and socially beneficial use of hydropower. The environmental policy in Lithuania is one of the most rigorous in the European Union. The unconditional prohibition of dam building in ecologically and culturally valuable rivers means that the untapped hydropower potential in Lithuania is only 5%.

**Keywords:** hydropower development, environmental impact, environmental policy, non-harmonized legislation, Lithuania.

**JEL Classification:** Q5.

### Introduction

The development of hydropower in Lithuania is determined by various legislation which changes in time due to objective and subjective reasons, and also depends on the management of RE sources sector. The integration of Lithuania into energy systems of the European Union (EU) is an integral part of the EU policy and, therefore, the legislation regulating RE sources development must be harmonized with EU law. EU directives encourage the development of RE sources, however, the ecological policy aggravates the construction of hydropower stations. This is also confirmed by experts who state that the existing shortcomings in legal regulation of the Lithuanian RE sources interfere with various administrative procedures. We do agree that, in order to achieve the development of RE sources, the environmental respect must first be observed, but this must not interfere with the development. European urban and regional studies carried out in Edinburgh (United Kingdom) showed that the implementation of the European Parliament and Council directives provided for unique opportunity to restore the ecological condition of water bodies (Ioris, University of Edinburgh, UK, 2015).

The development of hydropower is supported by the EU institutions. EU legislation in terms of hydropower and construction of new water reservoirs are favorable and scientific progress allows ensuring the principles of sustainable development. Many scientists also favorably assess the Lithuanian hydropower development potential; however, there is an opposing opinion that this economic activity has a negative effect on the

natural environment, and in particular its ecological condition. Therefore, the major problems are linked to environmental protection and, in Lithuania, they result in smaller-scale development than in other EU countries. Environmental restrictions in Lithuania prevent the development of hydropower, at the same time, limiting the flood protection and the establishment of the reservoir related businesses (Punys et al., 2006; Punys, Pelikan, 2007). Therefore, the management of the new public administration as the system of values and institutions must help the society to solve the issues of restriction by using the interaction between the state, public society, and the private sector. The public management process must create new opportunities relevant to the society, the context of which is determined by the institutions, which are the normative fundamentals (Vogelsang-Coombs, Keller, 2015; Bryson, Crosby, 2014; Schachter, 2014). Therefore, the new public management (the whole public sector) and the new public administration (executive authorities) must address the issues of rational use of energy resources.

The authors stress that in Lithuania, public policy obligations are not fulfilled due to the management problems in the RE sources sector. Hydropower development is supported by the European Commission via the Directive 2009/28/EC on the promotion of the use of energy from renewable sources and neglecting the political and economic processes of the European Union hinders the modernization of sustainable development and results in environmental restrictions. Therefore, it is essential that the Government improves the structuring of public administration institutions, functions, and problems by defining and directing the general objectives of the institutions at targeted performance of functions. For these reasons, today's state structure is necessary to facilitate and stimulate

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political alternative to the selection and rational decision-making and monitoring the implementation thereof.

All the above requires a different approach to the objectives, practices, and public administration problem resolution possibilities, and demands looking for more flexible methods and varied procedures for assessing the effect of the Lithuanian legislation on hydropower development. Management of the new public administration and optimization of organizational and technological structures should be functionally beneficial in creating the conditions for more effective hydropower and RE sources development.

**Problem.** The Lithuanian legal system does not promote the hydropower development in Lithuania enough and non-harmonized legislation creates barriers for effective and socially beneficial use of RE sources development.

**Aim.** To display the promotional effect of legislation regulating the environmental protection and RE sources development on hydropower, the following objectives were set to achieve this aim:

- ◆ to define the criteria for hydropower potential assessment;
- ◆ to disclose the main provisions of EU Water Framework Directive (WFD) regarding hydropower development;
- ◆ to overview the regulation of hydropower development;
- ◆ to establish the barriers created by legislation in Lithuania;

- ◆ to identify the socio-economic loss due to ecology and RE sources policies;
- ◆ to carry out the assessment of the effect of legislation and strategic documents on Lithuanian hydropower development in the final provisions.

**Methods** are the following: document content analysis and comparative analysis of legislation and scientific literature.

**Subject.** Related legislation management.

## 1. Discussion of the results

Scientists propose assessing the environment in the broad sense: physical, natural, social, and economical. RE sources (biomass, wind, sun, water, etc.) are considered to be environmentally-friendly. Despite of the fact that RE sources are “clean” methods of energy production, scientific studies are necessary to evaluate their effect on the environment. Therefore, it is appropriate to determine the potential in line with the environment, which could be used without causing damage. Doukas et al. (2007), Punys et al. (2010) note that the environmental impact assessors generally emphasize the theoretical or, at best, the technical potential, although the hydropower technology has already defined the limit between the theoretical, technical, economical, and realizable potential, first taking into account the environmental requirements. Such assessment results in rapid decrease from the theoretical to the realizable hydropower potential (Figure 1).

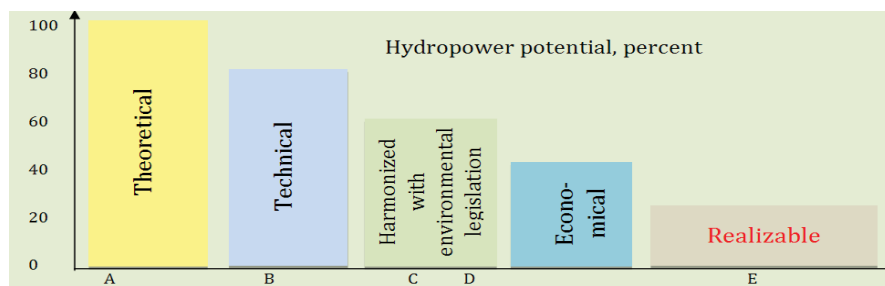


Fig. 1. Decrease of hydropower resources due to various restrictions (Punys et al., 2010)

The attempts to clearly distinguish between these potentials in the EU (assessment of the environmental impact and the use of hydropower resources) were implemented by the Blue Energy for A Green Europe (2001) and, later on, SHERPA (Small Hydropower Energy Efficiency Campaign Action, 2008) projects. The projects involved collecting and summarizing the hydropower resources determined by the experts. By theoretically analyzing the application of environmental legislation on the small hydropower resources (Landy, 2008), it was distinguished: a) the environmentally-friendly potential; b) the potential compatible with

environmental legislation; c) the potential compliant with the environmental good practice; d) realizable potential, which additionally assesses the social and other factors. The author emphasized that there was no precise assessment method for the components of this hydropower potentials and that common practice is to reduce the potential of the river stretches that are in the environmentally protected areas or where dam building is restricted due to other legislations. The hydropower potentials assessing various environmental and other restrictions are presented in Figure 2.

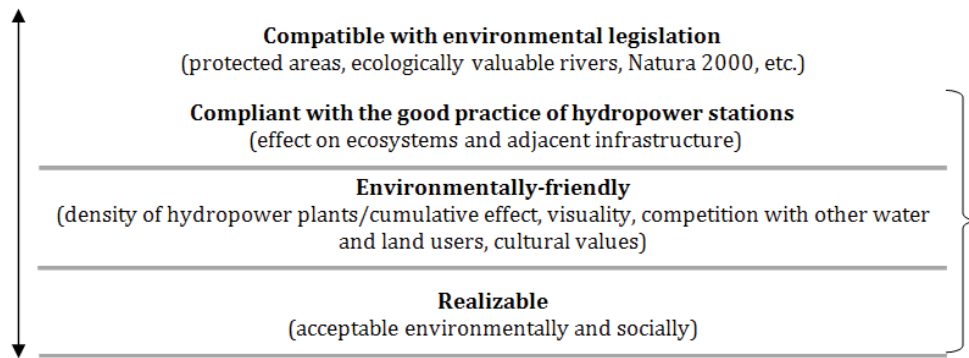


Fig. 2. Compatible hydropower and environmental procedures (Punys et al., 2010)

According to Punys et al. (2010), only the hydropower potential compatible with the environmental protection may be clearly and quantitatively defined. For assessment of other components of the potential, specific projects and their environmental impact assessment material must be analyzed. The authors note that environmental impact assessment procedures must reconcile the hydropower and environmental systems. If an authority decides that the planned economic activity is not permitted in the chosen location due to violations of respective laws and other legislation or potential negative environmental impact, the economic activity cannot be performed.

According to the authors, developing the environmentally-friendly hydropower potential, which would be socially and economically beneficial to the society, is advisable in Lithuania, as well as taking measures mitigating the ecological changes in the rivers. In order to eliminate the barriers and to realize this potential, the ecology policy must be compatible with the Renewable Energy Resources Law.

*1.2.1. The main provisions of EU WFD regarding the hydropower development.* New hydropower projects must be implemented in accordance with Article 4.7 of the European Union Water Framework Directive, which states that the impact of new, balanced human development activities (including hydropower) on water bodies is allowed, providing there is no deterioration in the water quality. Moreover, it requires performing a specific test to assess the impact of new human development activities (in this case, production of hydropower) (Landy, 2008; Common, 2007b). Cost-benefit analysis of a hydropower project must be carried out after determining whether the environmental and social benefit outweighs the benefits for human health and safety and sustainable growth. Two types of key studies are possible for the existing and new hydropower plants (HPP):

- ◆ **existing HPP:** if there are physical changes, the first step would be to restore the water body and

achieve good ecological status (GES). If a water body cannot be restored (the changes are very extensive), the mitigating measures should be applied in order to achieve good ecological potential (GEP). In both cases, the timetable may be extended (Art. 4.4) or less rigorous environmental objectives may be set (Art. 4.5), if the necessary measures are technically impossible or disproportionately expensive;

- ◆ **new HPP:** the first step would be not to deteriorate the state of the existing water body. If this is not possible, the measures mitigating the effects should be applied. If the development of a new HPP does not allow achieving GES or GEP, as well as preventing the deterioration of the water body, the only solution is to verify that the HPP is compliant with the requirements of Article 4.7 of WFD. Well-designed, monitored and sustainably managed small HPP would surely meet this requirement.

WFD hydropower planning implementation guidelines (Common ..., 2007a) proposed distinguishing the rivers suitable and not suitable for hydropower development. At least, three pre-planning levels for hydropower must be distinguished: 1) favorable; 2) less favorable; and 3) unfavorable locations. All stakeholders must participate in determining the locations of these levels based on clear criteria. The lists of locations must be monitored and reviewed on a regular basis. However, the black/white approach (for example, exclusive prohibition cases) is not suited here. Construction of the HPPs with minor environmental impact or compliant with the requirements of Art. 4.7 of WFD could be allowed in the unfavorable locations as well.

Pre-planning mechanism for hydropower with specification of locations suitable for construction recommended by WFD has great advantages. Therefore, when mapping the preliminary sites of HPPs, the WFD and other environmental criteria, as well as other socioeconomic factors and the interests of other water users must be taken into account. This



would speed up the issue of a permit, because WFD Article 4.7 requirements would be met.

Currently, in Lithuania, only 19% of the technical potential has been tapped (World Atlas and Industry Guide, 2014) and, therefore, it may be stated that the Lithuanian Government has not properly adapted the pre-planning mechanism of WFD when transferring the EU directive into national legislation, which resulted into the slow development of hydropower.

*1.2.2. Regulation of hydropower development.* All governments of the European countries have introduced their renewable energy policies supporting the electricity generation from renewable energy sources including hydropower. Nevertheless, the development of the hydropower in this region is considerably slowed down via the environmental requirements and legislation.

Some countries, seeking to protect fish and cultural values, have announced a list of rivers where building of HPPs and creating large reservoirs is prohibited. In Lithuania, it was done without any coordination with the WFD requirements (Punys, 2008). In many cases, construction of the HPPs is prohibited on individual rivers. For example, in Sweden, construction of dams is prohibited on 4 large rivers and individual sections of smaller rivers, and in Finland – on several large rivers only (Puranen, 2003). In Latvia, Lithuania, and Estonia, building dams was prohibited on 214, 169, and 122 rivers and their stretches, respectively. The environmental engineering specialists of Estonia are already having doubts about the benefit of such prohibitions on the development of small hydropower (Reihan, Loigu, 2006).

The analysis of the protected rivers and hydropower development opportunities on protected rivers and areas in France showed that less favorable and unfavorable sites for hydropower development are distinguished (Crepon, 2009). It is possible to implement hydropower projects on protected rivers. However, in Lithuania, there is no such possibility.

WFD provisions impacted the updating process of the hydropower development models in the EU countries, however, the Baltic states (Lithuania, Latvia, and Estonia) distinguished themselves swiftly by prohibiting damming of the majority rivers. In Lithuania non-compliable ecological and renewable energyresources policy was formed, what strongly impeded the further development of the hydropower sector.

*1.2.3. The effect of Lithuanian legislation on hydropower development.* Lithuania has strong institutional barriers – absolute and uncompromizing prohibition of dam building and, thus, hydropower development.

Clause 3 of Article 14 of the Water Law of the Republic of Lithuania states: “Building dams on the River Nemunas (Neman), as well as ecologically and culturally valuable rivers is prohibited”. The list of ecologically and culturally valuable rivers or their stretches was approved by the Government via the Resolution (“On ecologically and culturally...”, 2004) in 2004. The construction of dams for any purposes was forbidden on 169 rivers and their stretches.

The concept of ‘culturally valuable rivers’ is used without justification. Lithuania has only a few cultural reserves, which are not an object of interest for hydropower. ‘Cultural rivers’ include historical (e.g., water mills), ethnocultural, urban, and even archaeological values. Without going deeper into all of them, it is obvious that the latter are generally found out during construction work only. On the other hand, who can be sure beforehand about the damage to them, if there no studies are allowed for the potential projects.

According to WFD via the amendment to the Law on Protected Areas of the Republic of Lithuania (2000), it is prohibited to build dams on the natural rivers and create large water reservoirs in the reserves. Restoring former dams, creating water reservoirs or other hydraulic structures is allowed only when it is necessary for restoration and management of the cultural heritage objects in the reserves (except for strict reserves). In order to achieve environmentally friendly development of hydropower, the territories of reserves should be revised and divided into different reserveareas or an exception for the former water mills areas should be provided. The private hydropower sector is interested in restoring water mill dams and adapting them for electricity production, but it is prohibited on the most favorable river stretches. Therefore, a study is necessary for determining where the dams of former water mills could be restored. The environmental impact assessment (EIA) procedure could serve as grounds for making a decision about restoration. This would not apply to:

- ◆ strict reserves (any economic activity is forbidden);
- ◆ hydrographic reserves;
- ◆ salmonid spawning rivers (except for transit ones, e.g., Nemunas, Neris, etc.);
- ◆ exceptionally important ichthyological reserves (e.g., the river Žeimena).

In environmental terms, construction of dams on the rivers should be regulated at three levels:

- ◆ **unfavorable rivers** (strict reserves, ichthyological and hydrographical reserves, intense spawning rivers or their stretches, etc.);

- ◆ **less favorable rivers** (national and regional parks, Natura 2000 territories, former water mills in protected areas, fish migration routes, landscape reserves, etc.);
- ◆ **favorable rivers** (the rivers that do not run across the protected areas and do not have significant damage to river ecosystems).

Former water mills and remains of dams in reserves and conservation protection priority areas in Lithuania are on ichthyologically significant rivers. Some of these water mills also have status of the national heritage. The energy that can be produced annually on small and medium rivers of Lithuania under the current environmental restrictions is only around 117 GWh. In comparison to the majority of rivers that run across protected areas or where building dams is prohibited, these rivers are much poorer in terms of energy production.

It is proposed to restore the former water mills by ensuring proper protection of the landscape and the biological diversity and restoring the diminishing hydraulic heritage of hydropower. It is also proposed to revise the related legislation, first of all, the List of Ecologically and Culturally Significant Rivers (Resolution No. 1144 of 8 October 2004 of the Government of the Republic of Lithuania, Official Gazette, 10/09/2004, No. 137-4995), which unconditionally prevents the pursuance of this goal. Today, we have an untapped potential of small and micro hydropower, which is ecologically acceptable and may have a positive impact on the environment and fishery. This is in line with EU targets and has multiple benefits for the residents. Therefore, it is essential to increase the electricity production in small and micro hydropower plants by identifying and restoring the locations suitable for hydropower. The hydropower potential of small and medium rivers in Lithuania must be developed far more intensely.

Strict environmental laws in Lithuania are limiting the development of hydropower. Starting from 2007, only fourteen new small hydropower plants started to produce electricity. That means only 1.6 plant per year. Although, there is a possibility to get EU support to refurbish old water mill sites, currently there is no possibility to rebuild an old mill's dam if the site is in the culturally valuable river.

The potential of the two largest rivers in Lithuania: the Nemunas and the Neris comprises the whole large hydropower potential in the country. They account for over 80.2% of the whole technical potential, or 1,675 GWh per year (World Atlas and Industry Guide, 2014). Today, the development of large hydropower is not possible at all: building dams on these rivers is forbidden due to the

environmental protection law. This means not only the stagnation for large hydropower sector, but also for the navigation. The proposition is to look for solutions, the assessment of which would be based on the ecological effectiveness principle.

The laws should be harmonized in such manner that an opportunity for sea to in-land navigation route could be created by building low head dams in significant locations with possibility to install low head turbines. This could enable a complex use of inland waters in line with WFD and sustainable development of hydropower in Lithuania. In summary, it must be noted that the current barriers created by Lithuanian legislation prevents the development of the hydropower, small and large.

*1.2.4. Economic and social loss.* Hydropower, as well as other RE sources, can offer the best possibilities. It can be developed by reducing the impact on the environment. Fossil fuels are facing security problems and are causing climate change (Moriarty, Honnery, 2016). Hydropower is among the most economically and socially friendly means of electricity production, while the greatest integrity with the environmental protection is achieved when the water resources of a river are used for several water economy sectors instead of one. Therefore, electricity production is among the most efficient industries in terms of profit and provides a great infrastructure for the development of other sectors. The essence of ecological effectiveness is the lowest possible negative effect on the environment and the most economical use of natural resources (Hall, Branford, 2012; Notter, 2015).

Hydropower development should not endanger the social environment, cultural heritage or local communities and, therefore, the principles of sustainable development should be observed and the environmental protection and social development interests should be harmonized by ensuring a clean and healthy environment, the effective use of natural resources, as well as the social security. The social infrastructure is comprised of cultural, educational, public health, sports and wellness, recreation and tourism, and other objects of public use. The social factors, especially in rural areas, must ensure the rational use of natural resources, the means for regulating the occupation of the residents and the development of activity, as well as the harmonization of public and private interests. Moreover, the state urban structure, engineering, recreational and other social infrastructure systems must be optimized.

The rivers, where the potential is the highest are included in the list of ecologically and culturally valuable rivers and, according to the Water Law of the

Republic of Lithuania, building dams on them is forbidden. Therefore, the possibilities of hydropower development have been completely exhausted, unless the environmental laws are amended. If the environmental restrictions could be mitigated, the installed hydropower capacity could increase by at

least 30 MW. The energy resources of the rivers (close to the economically feasible potential) compiled with the environmental restrictions for hydropower development in these rivers show that under current situation, only 117 GWh of electricity may be produced per year (Table 2).

Table 2. Reduction of hydropower potential due to legal restrictions (Punys et al., 2010)

No.	Environmental assessment of rivers	Energy use assessment of rivers (priority)	Average electricity production GWh per year	Capacity MW
1.	Rivers suitable for HPP construction (unrealistic, if there were no protected areas, reserves and ecologically-culturally valuable rivers)	0	812	183
2.	Rivers with high environmental restrictions (natural or hydrographic reserves, salmonid spawning grounds, ecologically-culturally valuable rivers)	1	~617	~140
3.	Rivers with lower environmental restrictions (parks, less significant reserves and part of ecologically-culturally valuable rivers)	2	574	129
4.	Rivers without environmental restrictions (no protected areas, no ecologically-culturally valuable rivers) (current situation)	3	117	25

Economic energy losses due to legal constrain is up to to 617 GWh per year (or 30% of natural resources). Taking into account only the protected areas (without legal prohibitions on dam construction), they are reduced to 287 GWh per year (14% of natural resources). After the prohibition of dam construction became effective, it was reduced only to 5% (126 GWh per year). These are the resources of small hydropower, which could be actually developed. In European countries, the average of the actual undeveloped small hydropower potential is up to 25-35%. These 5% in Lithuania indicates the unjustified rigorousness of legislation prohibiting the dam constructions as well as the fact that prohibitions in Lithuania are among the strictest in Europe.

The amendment of Article 14 of the Water Law of the Republic of Lithuania (2003), which prohibits building dams on the river Nemunas and on ecologically and culturally valuable rivers unconditionally prevents the use of these rivers for economic and social needs.

The amount of electricity generation from water mills in Lithuania is not high; however, they are technical monuments and objects of heritage and, therefore, they must be preserved and restored, not demolished. However, the order of the Ministry of Agriculture of the Republic of Lithuania, adopted in 2007 concerning removal of the old mills dams' ruins impeding the fish migration is still valid. Scientists have proved that low head dams do not impede the natural water level fluctuation limits and having the necessary environmental measures have a positive effect on the environment (World Small Hydropower Development Report, 2013). Water mills have proven to be completely environmentally acceptable.

Today, there are many water mills dams' ruins in Lithuania. Only around 80 of these ruins are on ichthyologically valuable rivers and their reconstruction is not possible according to the Water

Law. Economical loss, in this case it is the untapped hydropower potential, is approximately 15 MW (total capacity of renovated HPPs) and electricity generation of approximately 50 GWh per year. If reconstruction of the former water mills could be permitted, firstly, the landscape would be tidied up, because not only the ruins can be not pleasant to the eye, but they also can be dangerous, secondly, there would be no necessity to build new dams on other rivers or damage their natural values. Although the untapped hydropower potential seems not high, the reconstruction of former water mills is sufficient to meet the provisions of the Energy from Renewable Sources Law of the Republic of Lithuania: to increase the installed total capacity of hydropower plants connected to power networks to 141 MW by 2020. Currently, this capacity is 128 MW. Social benefits for society in rural areas could bring added value to these projects.

Hydropower has a positive effect on navigation, water tourism, and development of recreational services, additional businesses, flood protection, water supply, restoration and fostering of cultural heritage. It has been proven both scientifically and practically that complex use of rivers for shipping, energy production, and fishing by increasing the water levels is very beneficial to society, particularly during dry periods. Navigation is seen as a sustainable component of the transport development, as it decreases the pollution and impacts to landscape of land transport (Winkel et al., 2016). The main inland water route of international and national significance in Lithuania is the river Nemunas from Kaunas to the mouth of Atmata and the Curonian Lagoon. Unfortunately, at the moment, cargo shipping on Neman is essentially non-existent. Low head dams could raise the water levels of the rivers and allow to open a cargo transit route on the river Neman from and to Belarus and to develop navigation on the river Neris up to Jonava,



where a cargo port had been planned, because, in Jonava, one of the biggest industrial factory in Lithuania is located.

Navigation projects are not attractive commercially. They could be made more attractive by combining with hydropower interests and conjoining the requirements for hydropower, navigation and environmental protection. The global experience shows that private businesses would invest into the development and infrastructure of waterways, if concession would be given to produce electricity. However, the authorities have not considered such proposals, because the Water Law of the Republic of Lithuania unconditionally prevents the construction of dams of any height on Nemunas and many other rivers. For example, a navigation development project was prepared, according to which the “river-sea” ships could sail in Nemunas and the shipping market would become open to Western countries. Similarly, in Kaunas Strategic Plan of 2005-2015, the plans were drawn for construction of a cargo port, improving the aesthetic appearance of the river, tidying up its banks by building embankments and piers and, thus, attracting investment into tourism and recreation. The Ministry of Transport and Communications of the Republic of Lithuania had planned a waterway on the river Neris up to Jonava (Litbioma, Action Plan for Promotion of Use of RE Sources 2010-2020). This could be an opportunity to combine the necessities for navigation and hydropower supported by EU.

The adoption of appropriate project businesses should have more opportunities to take part in construction of dams on the river Nemunas. The raised water level could create the favorable conditions for the development of cargo, passenger and recreational shipping. Self-propelled or dumb barges of 1000 tons and more and large passenger and industrial – cargo, passenger – touristic ships could sail in the river Nemunas, the network of ports and piers of internal waters could be expanded, as well as the infrastructure servicing the people. If cargo could be started to ship from the Klaipėda Seaport by inland waters, the pollution of cars and the load of heavy transport on the roads would decrease. Inland waters transport uses less fuel and, thus, it would contribute to the saving policy, as one 1,000-ton barge replaces 40 trucks. Tonne-kilometers of water transport use 17% of energy used by road transport and 50% of energy used by railway transport and, therefore, they are more cost efficient (Council Directive 2014, 452 final).

If the projects of waterways could be implemented according to the plans of local governments and the Ministry of Transport and Communications, 67 MW would be additionally installed and 530.6 GWh of

electricity would be additionally generated per year only on the river Nemunas. If permission would be given to restore the water mills in parks and less sensitive reserves, HPPs with the capacity of approximately 15 MW would be installed and 59.9 GWh of electricity would be generated per year. This would allow increasing a social attractiveness for tourism.

The current situation in Lithuania is not favorable for hydropower development. However, implementing the EU directives related to the use of RE sources, business interest and closing the Nuclear Power Plant of Ignalina creates a pretext for taking another look at the use of rivers for the needs of society and additionally to evaluate the need for balancing other RE sources (wind, sun).

*1.2.5. Final provisions.* Based on the results of content analysis, the shortcomings of legislation regulating hydropower development were identified: development of RE sources may promote or prevent the development of certain types of RE sources; non-harmonized documents are seen as barriers and found in the analysis of the legal base of Lithuania; in the current situation of Lithuania, it was found that the management of development of RE sources with respect to hydropower prevents the complex development of the sector.

Today, section 3 of Article 14 of the Water Law of the Republic of Lithuania violates the right granted by the Law on Environmental Impact Assessment of Planned Economic Activities to carry out an environmental impact assessment (EIA), as well as the natural right to develop economic activity. Therefore, it is necessary to analyze the use and protection of a natural river resources case-by-case by carrying out an EIA; the laws on Construction, Territorial Planning, Protected Areas, Protection of Immovable Cultural Heritage and Regional Development should be improved. Water Law also defies the Law on Protected Areas of the Republic of Lithuania, which regulates the construction of dams and reservoirs (Article 9): prohibits or allows the construction under certain conditions (e.g., restoring or managing the immovable cultural heritage objects). On the other hand, according to the nature of protected values, this law projects a type of zoological reserves with protected species of fish (ichthyological reserves) and the above restrictions apply to such reserves. Meanwhile, the List of ecologically or culturally valuable rivers or their stretches referred to in section 3 of Article 14 of the Water Law sets forth unconditional prohibitions on restoring the valuable objects.

The professional grounds of the amendment to the Water Law is explained by the fact that water reservoirs would soon be filled up with sludge, the

basin of the river Nemunas would be flooded and this would pose a threat to the historical, archaeological and even urban heritage. However, differently from the current leaders of the state and responsible persons, society does not agree with this provision and supports the development of hydropower. The advocates of hydropower believe that water resources may be used sustainably by combining the production of energy from renewable sources, the protection of river ecosystems and the development of water recreation and other surrounding businesses.

If water mills dams' reconstruction was permitted, natural values would be restored and the conditions for fish migration would be improved. State investment could be avoided by attracting the private capital and creating the legal conditions. This would also allow developing rural tourism, water recreation and diversifying the rural business. It has been scientifically proven that the use of river water for hydropower may improve the spread and migration of fish and the rational management of fishery.

The analysis of ichthyologic studies revealed that the approach to prohibition of building HPPs on ecologically and culturally significant rivers and their stretches is not correct. Therefore, the benefits of hydropower should be explained and the awareness should be raised with regard to environmentally-friendly and beneficial nature of small hydropower. On sustainable and economically viable basis, the studies should be carried out by applying the above mentioned three levels of hydropower pre-planning for rivers. Only carrying out the environmental impact assessment studies would allow collecting the objective information about the existing condition of rivers and the expected effect on the occurrence and migration of fish. Therefore, it is necessary to essentially revise the model of environmental impact assessment and adapt it to RE sources energetics, first of all, by permitting to carry out an EIA in protected areas. Revisions of valid environmental legislation (first of all, the Water Law) and the categories of protected areas are also necessary.

The amplification of the fish protection and promotion of national hydropower development require environmental, ichthyological and fishery studies. In order to raise the level of environmental science, the research work must be carried out more intensely than it is today (National Ichthyological Reserve Preparation Planning Program, 2010). The ichthyologists treat the construction of any hydraulic structures as irreparable damage to the populations of salmonids and other migratory fish. However, contemporary environmental engineering solutions such as construction of fish ladders and dam bypass canals or other advanced measures mitigate the negative effect on fishery. Therefore, the ichthyology

specialists must increase their awareness of fishery and hydropower advancement and management of the new technologies. Ichthyology and hydropower studies should be based on water ecosystem productivity evaluation, modeling and forecasting in accordance with water environment law and national policy.

Although the development of the RE sources is encouraged, the restrictions on construction of dams on the river Nemunas, as well as ecologically and culturally valuable rivers today can be regarded the shortcomings of the national policy. Prohibitions have been issued on damming and regulating natural rivers, changing their course and the natural water level of lakes in natural and complex reserves. Prohibition of construction (reconstruction) of dams on ecologically and culturally valuable rivers has considerably restricted the hydropower development. Lithuanian laws prohibit the construction of new hydropower plants or adapting existing dams for the electricity production. Meanwhile in "...developed countries hydropower is being developed along with other RE sources..." (Jager et al., 2015).

It must be admitted that hydropower have many qualities and have a positive effect on the nature. The use of such power plants instead of the widespread polluting power production methods would allow avoiding a considerable amount of pollutant emissions into the atmosphere. Abbasi T. and S. (2011) noted that that development of small hydropower has regained interest in the world. First, it is the cleanest source of energy with very little or no negative effects on the environment. Many researchers present a comprehensive analysis, whether such prevalence of small hydropower is justifiable, and by the use of favorable modern technologies substantiate the public benefit of small hydropower. In the recommendations are even included increasing the height of the dam, more effective use of reservoir resources during the wet season and replenishing the water loss from the neighboring hydrographic network. Also, more advanced turbines should be used what would help to adapt better to natural flow regime of the river. These measures allow increasing electricity generation in the small HPP without additional damage to the environment, implementation of the requirements for balanced use of water resources, encouraging their multiple uses, and ensuring the participation of all stakeholders in the hydropower development.

## Conclusions

Assessing the effect of the Lithuanian legislation on hydropower development, firstly, the application of environmental legislation and the hydropower



potential compatible with the environmental legislation must be evaluated, as well as the potential compliant with the good environmental practice and the realizable potential, which additionally assesses social and other factors.

Hydropower development should be implemented in accordance with the provisions of EU WFD, which provide that the impact of new and balanced human development activities on water bodies is allowed, provided there is no deterioration of the water status. In terms of environmental protection, construction of dams on the rivers should be regulated at three levels: unfavorable areas, less favorable areas and favorable rivers or their stretches. The pre-planning mechanism for locations of hydropower plants should also be applied.

An overview of regulation of hydropower development in different countries has revealed that it is possible to implement hydropower projects on protected rivers. In Lithuania, there is no such possibility.

The list of ecologically and culturally valuable rivers contravenes with the Law on Protected Areas of the Republic of Lithuania. Even carrying out an environmental impact assessment is prohibited *de jure*. It is an unprecedented case in the EU, because only detailed research allows determining whether there is an effect of economic activity on the environment, and if so, its mitigation measures may be established. The Law on Protected Areas of the Republic of Lithuania allows building or reconstructing dams even in natural reserves (for the purposes of restoring heritage objects, prevention of natural disasters, e.g., floods).

Maintaining the existing hydropower regulation in Lithuania results in the loss of competence of the

sector specialists, because only foreign market is favorable – in Lithuania, there are no conditions for the development of companies engaged in technical design of hydropower plants.

In terms of large hydropower (navigation on Nemunas), the country suffers from the prevention of expansion of the shipping route in a large part of Lithuania. A significant loss of the possible electricity production is also should be noted.

In terms of small hydropower (former water mills), the country loses not only the part of clean energy production, but also the possibilities of rural development and restoration of the cultural heritage objects, which could attract tourism and improve the landscape.

The results of the study have shown that the prohibitions of dam construction in Lithuania are imposed on nearly all large, medium and small rivers. The remaining rivers, where impoundment is allowed, have low discharge and are hardly suitable for energy production. Lithuania does not have an officially confirmed hydropower strategy and development program, the Water Law of the Republic of Lithuania, as well as other regulations is not favorable for development. It is proposed to allow building dams on ecologically and culturally significant rivers and their stretches with the purpose of restoring damaged and deteriorated cultural and technical heritage objects, as well as ensuring the protection of landscape, biological diversity and proper navigation conditions on inland waterways of national significance approved by the Government via the complex development of hydropower. The Lithuanian environmental legislation prevents the development of both large and small hydropower.

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