

Assessing the Profitability of New Investment Projects on Construction of Small HPP on HPS Crn Drim

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Abstract – The Crn Drim basin is the richest with water from all of Macedonia. The paper gives the overview of the analyses made on practical example of the energy contribution and economical evaluation of the new planned hydro power plants of the cascade on hydro energy system of Crn Drim River in Macedonia. The existing hydro energy system consists of two cascade hydro power plants and three reservoirs, but the operation experiences and the site location give the possibility to upgrade the system with additional hydro power plants. The technical calculations and power improvement are the base platform to make the economical evaluation of the NPV, B/C, PBP values for each power plant from all over integrated hydro energy system. The geographical configuration of the terrain and hydrological conditions of the region, especially the tributaries of Radika river, allow construction of more hydropower plants. These hydro power plants would improve the energy situation in Macedonia, and also would regulate the operating mode of existing HPP.

This paper will analyze more the hydropower projects in Crn Drim basin which are analyzed and planned for long time. The results presented in the paper are the energy production and economic viability of the construction and operation in power system.

Keywords – Economy, Hydro Power Plant (HPP), Energy.

I. INTRODUCTION

The main feature in the analysis of projects of hydroelectric plants is a high degree of uncertainty and imprecision of input parameters. Therefore, in order to perform an economic analysis of the projects, it is necessary to analyze multiple scenarios to determine the likelihood of certain option and meet investor risk investments of the HPP. As a challenge to show the many projects of hydroelectric determine those that are economically viable and feasible to consider those who the developer would guarantee the quickest return on investment. For this purpose will be determined and analyzed the financial performance of the planned investment of small hydropower on HS Black Drin.

The economic value of the power plants representing the following categories: NPV (Net Present Value), BCR (Benefit Cost Ratio), PBP, (Pay Back Period), IRR (Internal Rate of Return).

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II. BASIC PARAMETERS FOR THE SMALL HPP

This includes all projects of hydro power plants with installed capacity below 10 MW, which according to their projected energy parameters are treated as small hydropower plants with a reduced price of electricity in high tariff from 50 to 65 € / MWh and the low tariff of 45 € / MWh in correlation with preferential prices from Energy Regulatory Commission (ERC) of RM. In that group of potential small planned include: HPP Tresonce, HPP Gary, HPP Selce, HPP St. Petka and HPP Kosovrasti. These new hydropower plants are mostly tributaries of the supply to be used for filling the reservoir of potential HPP Boskov Most of Mala reka, and the existing reservoir of Debar Lake.

TABLE I
TECHNICAL PARAMETERS FOR THE PLANNED SMALL HPP ON HYDRO SYSTEM CRN DRIM

	P_{inst}	W_{year}	CF- Capacity Factor	Economic analysis
	[MW]	[GWh]		
Tresonce	8	21	0.30	Indiv. project
Gari	2.7	9	0.38	Indiv. project
Selce	3.3	9	0.31	Indiv. project
Sv.Petka	1.2	4	0.38	Indiv. project
Kosovrasti	5.4	18	0.38	Indiv. project

Expected electricity production or capacity factor depends on annual production:

$$CF = \frac{W_{year}}{8760 \cdot P_{inst}} \quad (1)$$

Where is:

W_{year} - annual production of electricity,

P_{inst} - installed power units.

III. FINANCIAL INDICATORS FOR THE PLANNED SMALL HPP OF HS CRN DRIM

Small hydropower plants are have the following common input parameters: operation life of 20 - 25 years of the loan repayment of 10 years. The following table 2. presents an

overview of the economic indicators (NPV, B/C, CF, T_{kred} , T_{oper} , C_{ht} and C_{lt}) of the project analyzed the Small HPP hydro system Crn Drim. This presents economic indicators after all discounted benefits and costs. Where: T_{kred} - time of repayment of the loan in years; T_{oper} - operating life of the plant, number of years of operation for economic profit; C_{ht} - work in high tariff (peak load); C_{lt} - work in low tariff (base load).

Net Present Value (NPV) is obtained as:

$$NPV = NPV(B)_{1-n} - NPV(C)_{1-n} \quad (2)$$

The B/C ratio is obtained as:

$$BCR = \frac{NPV(B)_{1-n}}{NPV(C)_{1-n}} \quad (3)$$

Where is:

$NPV(B)_{1-n}$ - benefits for the whole operation life,

$NPV(C)_{1-n}$ - costs during HPP operation life.

TABLE II
ECONOMIC INDICATORS FOR PLANNED INVESTMENT PROJECTS OF
SMALL HYDRO POWER PLANT ON CRN DRIM BASIN

HPP	NPV (€)	B/C	CF	T_{kred} - T_{oper} (year_year)	C_{ht} - C_{lt} (%_%)
Tresonce	2.316.40	1,21	0,30	10_25	60_40
Gari	2.435.79	1,33	0,38	10_20	60_40
Selce	1.217.89	1,33	0,38	10_20	60_40
Sv.Petka	465.89	1,10	0,31	10_20	60_40
Kosovrasti	792.99	1,45	0,38	10_20	50_50

On figure 1. and figure 2. presents graphical representations of economic indicators NPV and B/C for evaluation of new

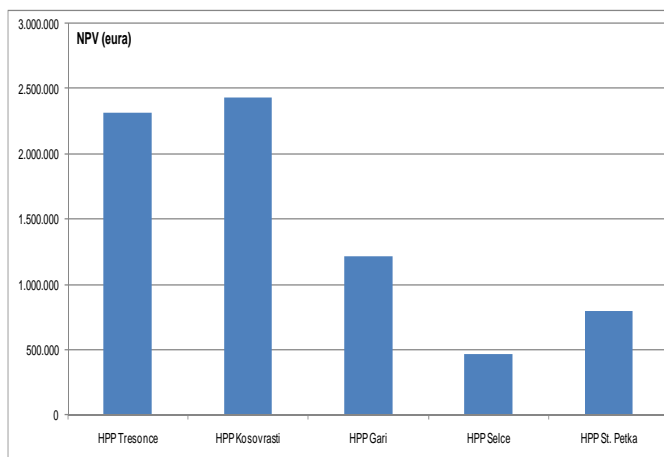


Fig. 1. NPV value for hydro projects on Crn Drim

hydro power projects HPS Crn Drim.

The table and graphical presentation clearly show which projects are the most attractive for investors, as the group of small HPP, such as: HPP Gari, HPP Kosovrasti and HPP St. Petka. These plants have the highest factors of NPV and $B/C > 1,3$. Fig.3 shows the operational energy parameter of CF (capacity factor) for each hydro power plant which is directly connected to the economical indicators. CF is certainly linked to economic indicators, or those projects that have high economic indicators have high energy production with CF about 0,4. The peak load power plants have low CF which is about 0,3, such as: HPP Tresonce, HPP Selce.

The following figure 3. presented is a graphic indicator of exploitation CF for all hydropower projects analyzed, which is of course directly related to the the economic indicators for each project.

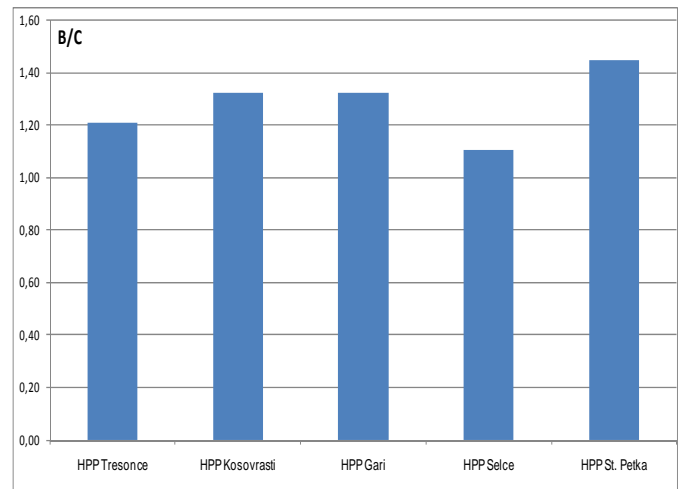


Fig. 2. B/C ratio for hydro projects on Crn Drim

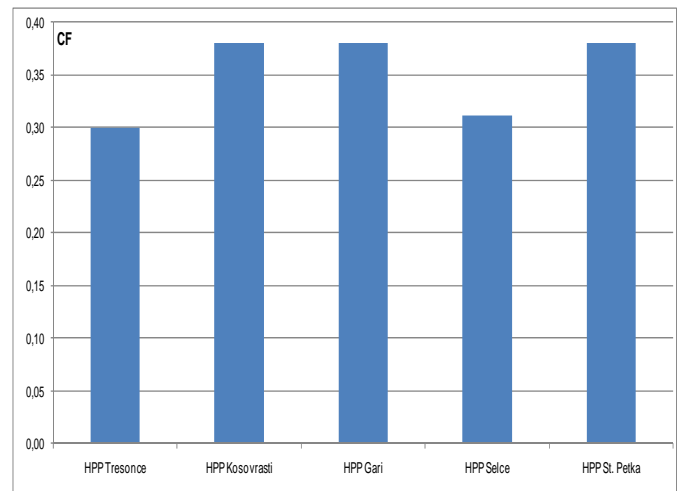


Fig. 3. CF for new small hydro projects on Crn Drim

Capacity factor CF gives the expected energy production which is strongly connected with economic indicators. HPP Kosovrasti, HPP Gary and HPP Sveta Petka have CF value about 0.38 which is actually highly acceptable value. HPP Tresonce and HPP Selece have low CF which is

approximately below 0.3 which means that they have to operate in the peak load.

IV. CONCLUSION

The specific natural geographical position of the Crn Drim basin with all facilities (power plants, reservoirs and supply channels) plays an important role in the power system of Macedonia. With new hydro power facilities, the goal is to improve the energy value of the whole hydro system of Crn Drim as the followings:

- increased installed capacity,
- higher production of electricity,
- reduce spillovers,
- increased number of operation hours in peak load,
- reduced number of operational work as base load power plant.

Improving the energy value of hydropower production complex will certainly contribute to the financial benefit of the whole hydro complex. The main benefit of the system is the increased installed capacity and increased electricity production as well as reducing the spillover. Operating on the hydro power plants in the high tariff of peak load is particularly important in dry hydrology, and wet hydrological conditions can be avoided or minimized the overflows.

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