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ENERGY REGULATORY OFFICE
REGULATORNI URED ZA ENERGIJU

Analysis of feed-in tariffs for small hydro-plants CONSULTATION PAPER

DISCLAIMER

This consultation paper is prepared by ERO in order to obtain comments and standpoints of the shareholders. This document should not be considered as to represent an ERO decision .

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Content

Abbreviations and Acronyms

CF – Capacity factor

EP – Generated Energy

JE – Economic asset life

Kd – slope

KEP – Energy Generation Costs

KI – Installed Capacity

KM – Maintenance costs

KO – Operational costs

KOK – Capital costs

KOM – Operational and Maintenance cost

KU – Water costs

MEM – Ministry of Energy and Mining

MPKK – Weighted average Cost of Capital

SHSHEMZHQ – Albanian Association for Sustainable Development of Energy and Environment

TAL – Allowed Revenue

TALM – Allowed Average Revenue

TKV –Total of Annual costs

VIF – The value of the initial investment

VNF – Net value of assets' at the beginning of the year

VNV – Net value of assets' at the end of the year

ZHV – Annual depreciation

1. Introduction

This report has been prepared by ERO , aiming the quantitative forecasting of the generation costs of renewable energy with new capacities and it is a tariff review of these capacities especially focused in hydro-energy. The data are mainly based in the document "Pre-feasibility study on identification of water sources for small hydro-plants in Kosova" prepared for the Ministry of Energy and Mining (MEM) by the Albanian Association for Sustainable Development of Energy and Environment (SHSHEMZHQ).

The report covers the anticipation of the total allowed incomes that may be earned from the regulated tariffs and the principles that determine the structure of the tariffs used to recover these annual incomes. The report entails the hydro-plants tariff calculation method, the installed capacity of which varies between 300 kW through 8300kW.

2. Selection, Categories and Timelines

2.1 Fulfillment of Indicative Targets

The amount of energy needed to be consumed from renewable energy until 2016 is set forth in the document "Administrative Instruction No.06/2007" ," On indicative targets for consumption of electrical energy and heating from renewable sources and co-generation" of the Ministry of Energy and Mining. These indicative targets may be seen in table 1:

No.	Energy Source	Indicative objectives for consumption of the energy generated from renewable sources (GWh)									
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1	Hydro	125,84	134,56	145,03	156,31	167,01	178,40	190,50	203,18	216,67	230,39
2	Wind	0,00	0,00	0,00	32,56	68,73	108,51	151,89	199,80	252,14	309,94
3	Solar	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
4	Biomass	0,00	0,00	0,00	0,00	11,63	17,45	19,77	23,26	29,08	29,08
	TOTAL	**125,84**	**134,56**	**145,03**	**188,87**	**247,37**	**304,36**	**362,16**	**426,24**	**497,88**	**569,40**

Table 1

According to the document in question, in 2016 at least 230.39 GWh of electrical energy generated from hydro-energy should be consumed.

2.2 Selection of hydro-plants included in tariff

The hydro-plants are selected depending upon their efficiency and feasibility. An indicator of that is the energy sales tariff from the generator to the public supplier.
Initially all the hydro-plants which generate energy with a tariff equal to or below the import price were considered feasible, accumulating a national generation of 291.67 GWh. Yet, since the required amount of energy generated from small hydro-plants, set forth in the administrative direction, is only 145.03 GWh in 2009, the generated energy in

Kosova in the occasion of constructing all the small hydro-plants, exceeds that indicative target as displayed in the table 2.

No.	Energy Source	Indicative objectives for consumption of the energy generated from renewable sources (GWh)									
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1	Indicative Hydro-obje	125,84	134,56	145,03	156,31	167,01	178,40	190,50	203,18	216,67	230,39
2	Generation from SHP	291,67	291,67	291,67	291,67	291,67	291,67	291,67	291,67	291,67	291,67
	Difference (2) - (1)	**165,83**	**157,11**	**146,64**	**135,36**	**124,66**	**113,27**	**101,17**	**88,49**	**75,00**	**61,28**

Table 2

Thus, the hydro-plants favorized in the calculation of the electrical energy tariff are those which fulfill the abovementioned indicative objective with highest feasibility and lowest tariff.

2.3 Break-down according to Generation capacities

Intending so the evaluated costs reflect as accurately as possible the hydro-plants' real costs, the tariff review has been performed in three groups depending on the installed capacities of the hydro-plant. Break-down according to the generation capacities has been made based on the Decision of the Kosova Government No. 05/250 "On feed-in measures for electrical energy generation from renewable sources and the electrical energy from co-generation in Kosova for the period 2007-2013". The abovementioned decision dictates the tariffs are determined pursuant to these categories:

I. Installed capacity of 0 MW to 2 MW
II. Installed capacity of 2 MW to 5 MW
III. Installed capacity of 5 MW to 10 MW

2.4 Tariff Timelines

Taking into account the investment costs and the average maturity time of long-term and large investments, it is decided that the tariff is calculated as an average of 10 years.

3. Principles and Formulation of Tariff Methodology, Rate of Return (RoR)

3.1 Allowed Revenue for a 10 years period

By "Allowed Revenues" is implied the anticipated calculation of the allowed revenues needed to cover the total annual costs of the investor, including operational and maintenance costs, asset depreciation and allowed return.

The allowed incomes are calculated according to the following formula:

$$TAL = KOM + ZHV + KOK \quad (1)$$

TAL = Allowed Incomes
ZHV =Annual depreciation
KOK = Capital costs
KOM =Maintenance and Operational Costs

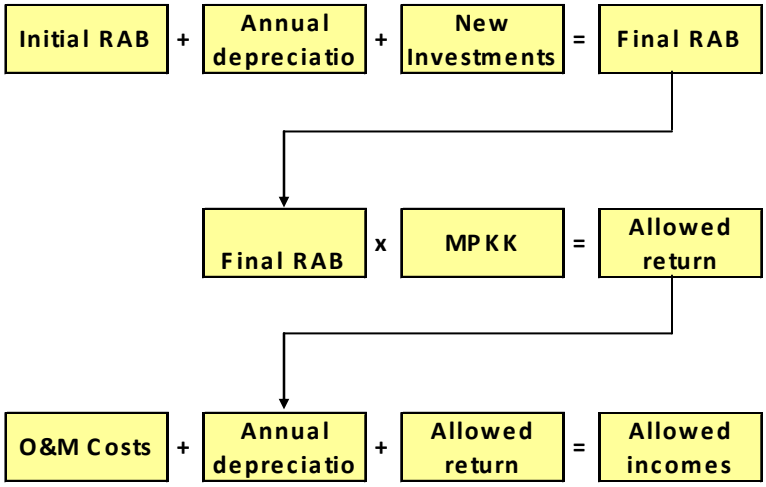

Chart 1: The calculation chart of the allowed incomes

3.2 Capital costs

Capital cost is calculated by multiplying the weighted average cost of capital with the end of year net book value of the asset.

$$KOK = MPKK * VNF$$

KOK –Capital costs
VNV – Net asset value at the end of the year

where

and $$MPKK = (1-g)*(r_f + ERP_i) + g*(r_f + DRP_i) = 13.8\% \quad (3)$$

MPKK –Weighted Average Cost of Capital
g - Leverage (Coefficient) of debt(debt / debt + equity)
r_f *-Risk-free rate*
ERP_i *- Premium of the equity risk for company i*
DRP_i *- Premium of the debt risk for company i*

MPKK is used to calculate the allowed return and presents the evaluated financing costs for the generator. MPKK is a weighted average of the financing costs from debt and equity, where each of these is expressed as a risk-free rate (presenting financing costs for risk-free assets) plus the premium of risk that presents the additional risks from taking

loans from generator or equity purchase in generator. The calculated profit compared to the actual financing costs is used to offer stimulation for the generator in order to request commercial financing with costs below MPKK determined by ERO in previous tariff review for KEK and KOSTT.

3.3 Annual Depreciation

Annual depreciation is calculated in linear way by assuming a 35 years long asset life. So,

$$ZHV = VIF * \left(\frac{100\%}{JE} \right) \qquad (2)$$

ZHV = Annual Depreciation
VIF = The value of the initial investment
JE = Economic Asset life

3.4 Evaluation and Determining of the Allowed Operational and Maintenance Costs

3.4.1 Operational Costs

Operational Costs accepted for tariffs entail personnel costs, water costs determined pursuant to Administrative Direction on Water Payments Structure and other costs

3.4.1.1 Personnel Costs

In the MEM study it is evaluated that the operational costs do not depend much on the installed power and vary between 45.000 and 60.000 €/year.
Taking into account this fact it has been decided that these costs are applied in a linear manner depending on the installed capacity. The smallest hydro-plant has an installed capacity of 300 kW. A minimal operational cost of 45,000 € is associated to this hydro-plant. The biggest hydro-plant has an installed capacity of 8300 kW and a maximum operational cost of 60,000€ per year is accepted to it. These combinations of the Installed Capacity and Operational Costs may be set as follows:

$$P_1 = (KI_1, KP_1) = (300, 45.000) \text{ and } P_2 = (KI_2, KP_2) = (8.300, 60.000) \qquad (4)$$

where

$$(KP_2 - KP_1) = kd * (KI_2 - KI_1) \qquad (5)$$

$$Kd = slope = \left(\frac{\Delta KP}{\Delta KI} \right) = \left(\frac{KP_2 - KP_1}{KI_2 - KI_1} \right) = \left(\frac{15}{8} \right) \qquad (6)$$

$$KP_2 - 45{,}000 = \left(\frac{15}{8}\right) * (KI_2 - 300) \qquad (7)$$

Thus, the personnel costs (according to the formula below) are accepted to all hydro-plants with an installed generation capacity between 300kW and 8300kW

$$KP = \left(\frac{15}{8}\right) * KI + 44{,}437.5 \qquad (8)$$

KP = Personnel Costs
KI = Installed Capacity

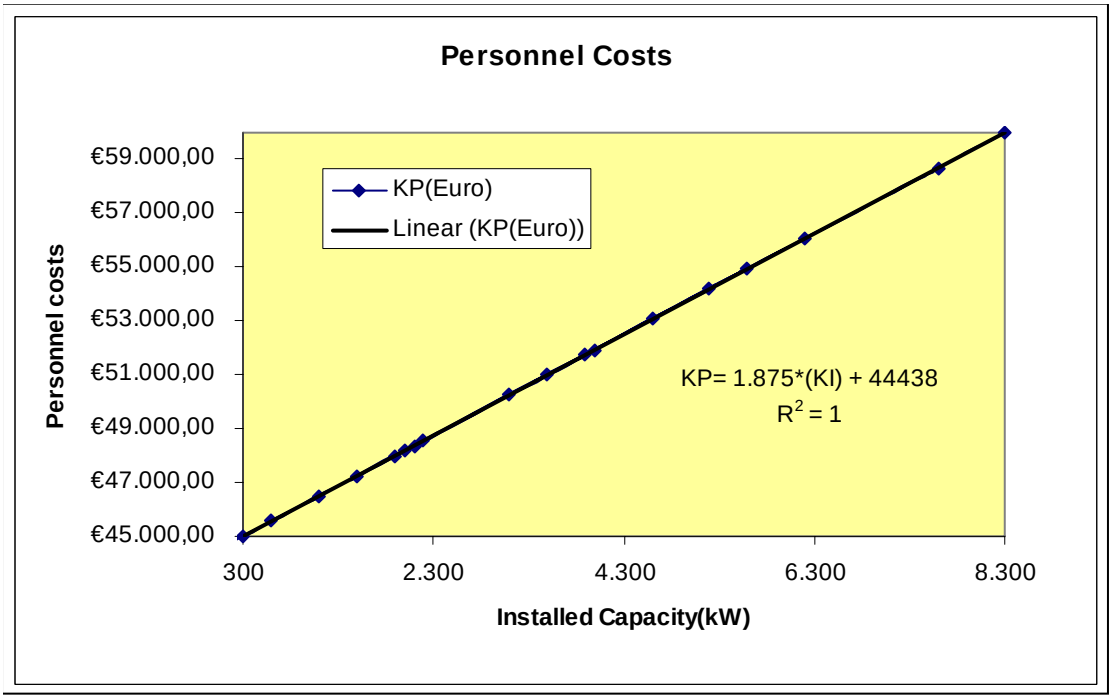

Chart 1

3.4.1.2 Water Costs

Costs' setting of the raw material (water) is based in the document " Administrative Instruction on the water payments' structure". Article 2 of the same document quotes "Compensation for usage of the superficial waters, underground and mineral waters is determined as follows: Electrical Energy Generators for each kW-hour generated in the hydro-plant 2.5% of the sales price". Accordingly, the water costs have been added to the final tariff pursuant to the mentioned administrative direction.

3.4.1.3 Miscellaneous costs

In these costs are included other not-calculated expenditures which have been approximated at the amount of 10% supplement to the total costs. Here are included the

security expenses, fuel expenses, wages, interest expenses, municipal obligations and other unanticipated expenditures. (The value of 10% is the approximate expense value of the mere category of “”Triangle General Contractors, Inc.”)

3.4.2 Maintenance Costs

MEM’s survey has evaluated that a hydro-plants maintenance costs should be 1.5 % of the main investment value and are expected to be constant for the years to come.

4. Tariff Calculation

4.1 Tariffs of a hydro-plant

The term “Tariff” implies the average total costs per kWh necessary to cover at least the allowed annual incomes as calculated in section 3.1 of this report. The tariff of a hydro-plant alone has been derived by calculating the average of the allowed incomes for 10 years in ratio with the amount of the generated energy.
Mathematically that would be:

$$TARIFA = \left(\sum_{i=1}^{10} \frac{TAL_i}{i} \right) * \frac{1}{EP_1} = TALM * \frac{1}{EP_1} \text{ , for each i Hydro-plant} \qquad (9)$$

TALi –the allowed incomes for the I year
EPi – the energy generated from the hydro-plant in question
TALM –Allowed average incomes for 10 years

The energy generated (EP) from a hydro-plant is calculated by multiplying the Capacity Factor (0-100%) with a maximal energy value that may be produced by a hydro-plant. The capacity factor is taken from the MEM survey that is an indicator between the total ratio of kWh’s generated from the anticipated water flow compared to the maximal theoretic generation value as if the water would flow throughout the whole year continuously. The average of the capacity factors of all the plants given in MEM’s survey is 53%, which implies that all the hydro-plants in average will be able to produce the maximum of their capacity 53% of the time. It should be stressed out that this number could be over-evaluated taking into account the fact that hydro-plant Triangle General Contractors (Lumbardhi) last year generated with a capacity factor of 33%. The capacity factor significantly impacts the tariff value thus its accurate determination is very important.

4.2 Overall Tariff

Calculation of the overall tariff has been done by adding the allowed 10 years incomes average (TALM) for each of the plants, and by dividing it with the sum of the generated quantity from all the plants in MEM's survey (weighted average of the anticipated costs in all the plants). Mathematically that would be,

$$TARIFA = \frac{\sum_{j=1}^{m} TALM_j}{\sum_{j=1}^{m} EP_j}$$, where *j presents the respective hydro-plant (10)*

TALMj = The allowed average10 years incomes for the hydro-plant j
EPj = Energy generated by hydro-plant j

Calculations deriving based on this technology have dictated the categorized tariffs to be as follows:

Installed Capacity	*Tariff(Eurocent /kWh)*
Hydro-plants up to 2MW	*6,44*
Hydro-plants from 2MW through 5 MW	*5,02*
Hydro-plants nga 5MW through 10 MW	*4,02*

Table 3

4.3 Feed-in Tariff

In order for the proposed tariffs to attract investments in small SHP from foreign investors as well as reasonable returns of investments, the countries which apply feed-in tariffs offer various measures. ERO proposes that the tariff resulting from the allowed incomes be added a feed-in of 10%-15% of the energy generation costs.
Since it is rational that the indicative targets determined by MEM be fulfilled with the lowest costs and the highest affordability of the customer, it is advised that the feed-in part of the tariff be higher for hydro-plants with a lower energy generation costs in order to attract the construction of more feasible hydro-plants. Furthermore, ERO proposes that the feed-in part of the tariff on the generation costs for the 5MW-10MW installed capacity hydro-plants to be 15%, while for smaller hydro-plants to be only 10%.

5. The Impact of New Hydro-Plants Tariff in the Overall tariff

The current energetic situation in Kosova dictated the import of 539.9 GWh of electrical energy in 2007, with an average price of 84€/MWh, and the energetic tariff situation has been as follows:

	National Generation					
	KEK	UJMANI	TGC	Import	Total	Tariff (€/MWh)
Generation (MWh	4407300,0	76000,0	28000,0	539812,0	5051112,0	26,47
Price	€ 19,4	€ 24,0	€ 40,0	€ 83,8		
Value	85.523.096,32	1.824.000,00	1.120.000,00	45.230.847,48	133.697.943,80	

Table 4

In the event of including the new generation capacities into calculation, the national generation increases by 154.8 GWh a year with a lower price compared to import. Therefore, it is rational that this amount of energy be subtracted from the imported sum. Nonetheless, since all the hydro-plants in question are flowing hydro-plants, it cannot be dictated when the hydro-energy is generated and the correlation between the imported and generated energy ought to be approximated. Considering the in-country increasing request and the fact that the energy import is mainly carried out during the peak hours, it is foreseen that the hydro-energy may replace only 33% of the imported energy since this percentage coincides with the peak timelines.

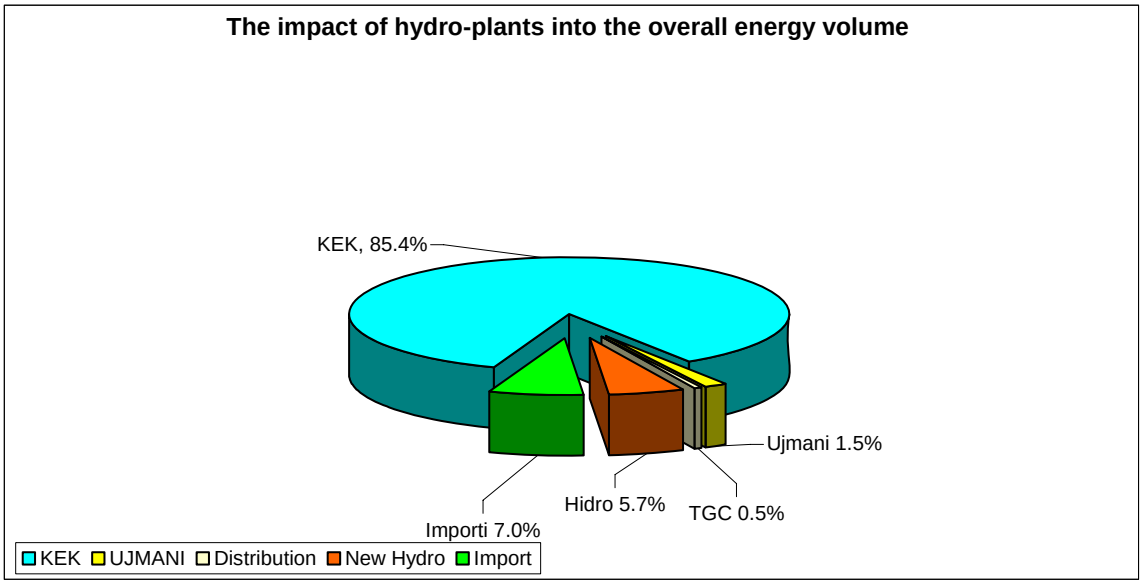

Chart 2

In case that the in-country energy requirement increase trend does not change and all the viewed hydro-plants are constructed, the overall tariff would be 3.8% lower and such a tariff would favor the customers.

	National Generation								
	KEK	UJMAN	TGC	New Hydros			Import	Total	Tariff (€/MWh)
Generation (MWh	4407300,0	76000,0	28000,0	34090,9	84741,1	150834,2	3598714,7	5.140.840,93	25,50
Price	€ 19,4	€ 24,0	€ 40,0	€ 64,42	€ 50,21	€ 40,22	€ 83,7		
Value	85.523.096,32	1.824.000,00	1.120.000,00	2.196.178,61	6,066,630.29	4,255,195.88	30.107.474,49	131,092,575.58	

Table 5