УЛОГАТА НА ХЕ ПОСТРОЈКИ ВО ТРАНЗИЦИЈАТА КОН ОБНОВЛИВИТЕ ИЗВОРИ НА ЕНЕРГИЈА – СТУДИЈА НА СЛУЧАЈ ЗА ПУМПНО - АКУМУЛАЦИОНАТА ПОСТРОЈКА „БИСТРИЦА"

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Резиме

Во енергетскиот сектор се случуваат неколку неповолни процеси. Значајните капацитети на обновливите извори на енергија како што се ветерот и сонцето, кои имаат променлива и непредвидлива достапност, се пуштаат во употреба без детални анализи за нивното влијание врз електроенергетските системи. Во меѓувреме, големите термо и нуклеарни централи, кои традиционално обезбедуваат стабилност и доверливост на електроенергетскиот систем, се деактивираат. Овие процеси значително ја менуваат улогата на хидроцентралите. Сите видови на хидроцентрали стануваат сè поважни, особено оние со големи резервоари за складирање на вода и пумпно – акумулационите хидроцентрали. Во такви случаи, хидроцентралите имаат потенцијал да го балансираат системот за обновлива енергија на краток рок (од секунди до минути), додека пумпно – акумулационите постројки може да обезбедат средно до долгорочно балансирање (месеци или дури години).

Рефератот го разгледува трендот на зголемување на количината на конвенционални и обновливи извори на енергија (ветер и сончева енергија) од една страна, и стагнација на предвидливи извори на хидроенергија. Тој го прикажува расположливиот хидроенергетски потенцијал во Србија и реалните можности за негово искористување. Дополнително, се опишува еден од најперспективните хидроенергетски објекти, пумпно – акумулационата ХЕ Бистрица, (која моментално е во фаза на идејно проектирање) како дел од хидроенергетскиот систем Лим-Увац.

Клучни зборови: обновливи извори на енергија, ХЕ капацитети, ПАХЕ, балансирање на енергија

THE ROLE OF HYDROPOWER PLANTS IN THE CONTEXT OF RENEWABLE ENERGY TRANSITION - CASE STUDY OF PUMPED-STORAGE HYDROPOWER PLANT BISTRICA -

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Summary

Several unfavourable processes are occurring in the energy sector. Significant capacities of renewable energy sources such as wind and solar, which have variable and unpredictable availability, are being commissioned without detailed analyses of their impact on electric power systems. Meanwhile, large thermal and nuclear power plants, which have traditionally provided stability and reliability to the power system, are being decommissioned. These processes are significantly altering the role of hydropower plants. All types of hydropower plants are becoming increasingly important, particularly those with large water storage reservoirs and pumped-storage hydropower plants. In such cases, hydropower plants have the potential to balance a renewable energy system in the short term (seconds to minutes), while pumped-storage plants can provide medium to long-term balancing (months or even years).

The article discusses the trend of an increasing quantity of volatile and intermittent energy sources (wind and solar) on one side, and stagnation of predictable hydropower sources. It presents the available hydropower potential in Serbia and the real possibilities for its utilization. Additionally, it describes one of the most promising hydropower facilities, the Pumped-storage Hydropower Plant Bistrica, (which is currently in the conceptual design phase) as part of the Lim-Uvac hydropower system.

Key words: renewable energy sources, hydropower capacities, reverse hydropower plants, energy balancing

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1. INTRODUCTION

Electrical power systems (EPS) have been developed for over a century through an optimal combination of power plants characterized by: (a) stabile production, (b) flexible management in terms of raising and lowering the capacity, (c) high reliability in managing cold, stand-by and spinning reserve capacities, (d) stability and predictability of directions and loads on the transmission network. All these attributes of reliability, predictability, and controllability were enabled by different types of power plants harmoniously integrated into mixed EPS:

- hydropower plants with various levels of flow regulation (from run-of-river to the most valuable storage hydropower plants with annual regulation) and with very high manoeuvrability (quick start-up and power increase);
- thermal power plants, with their key values: production stability, predictability and reliability in planning the delivery of demanded capacities, and with the drawback of being slow in increasing operating load, especially when starting from the cold reserve;
- gas power plants, characterized by significant operability (manoeuvrability) comparable to hydropower plants;
- nuclear power plants (NPPs), similar to thermal power plants in characteristics, but with greater operational inertia (power raising and lowering is not rational for NPPs), leading them to be scheduled in the base part of the daily load curve during production planning.

These characteristics of the power plants enabled optimal planning of their utilization throughout the daily and weekly plans, and even in formulating the rough annual plans for EPS.

In the second half of the 20th century, reversible (or pumped-storage) hydropower plants (RHPP) of high capacities have been introduced into EPS. Their task was to balance energy surpluses and deficits in stable and reliable systems, which typically arise due to uneven water regimes and disparities (or gaps) in energy production and demand.

With the increasingly pronounced requirement for transition to so-called "renewable and environmentally clean" sources of energy, primarily wind and solar energy, radical changes in EPS are undergoing. The following facts are of great importance:

- Stable, reliable, predictable, and controllable energy sources (thermal and nuclear power plants), sources that provided full balance security to EPS, are being phased out.
- These stable and controllable energy sources are being replaced by highly unpredictable sources in terms of availability – wind and solar energy. The intermittency, unpredictability, variability, and uncontrollability of these sources are most unfavourable characteristics, varying over time intervals.
- Even more unfavourable is the rapid and frequent variability of wind and solar energy availability. In the continental Balkan area, winds are not constant or predictable (like in zones along the coast of the North and Baltic Seas). Instead, there are highly frequent wind availability patterns.
- The transmission network in EPS, built and expanded over decades, was designed for configurations of power plants with conventional sources (locations of large thermal power plants, NPPs). However, as new intermittent renewable sources are being constructed in entirely different locations (large wind farms and solar power plants are built in areas previously without power plants, only consumers), the entire network no longer suits the new situation. Consequently, "bottlenecks" in the transmission system will appear, requiring a radical change of the existing network.
- Transmission flows within the network used to be entirely predictable, controllable, with a consistent transmission direction – from major sources to large consumption areas. In the new circumstances, where the primary sources are highly variable (intermittent), the network becomes extremely unstable as flow directions constantly shift within it, as well as the loads.

2. RENEWABLE ENERGY SOURCES

As a result of actions taken to reduce greenhouse gas emissions (from the Kyoto Protocol in 2005 to the Paris Agreement in 2016), the world is experiencing an exponential increase in wind and solar power capacities. Figure 1 illustrates the total capacity and generated energy from renewable sources worldwide. A mild exponential growth of renewable energy sources can be observed. However, the growth in installed capacity is significantly faster than the increase in generated energy. When considering different types of renewable energy sources, the situation becomes even more intriguing: for wind and solar energy, the rapid increase in installed capacity is not matched by a corresponding rise in generated energy. In 2010, the installed capacity of hydropower plants accounted for over 75% of the total renewable energy capacity, producing about 82% of the energy from that source. These ratios were significantly different in 2020: the share of hydroelectric power capacity had decreased substantially to around 43%, while energy production accounted for almost 60% of the total energy generated from renewable sources.

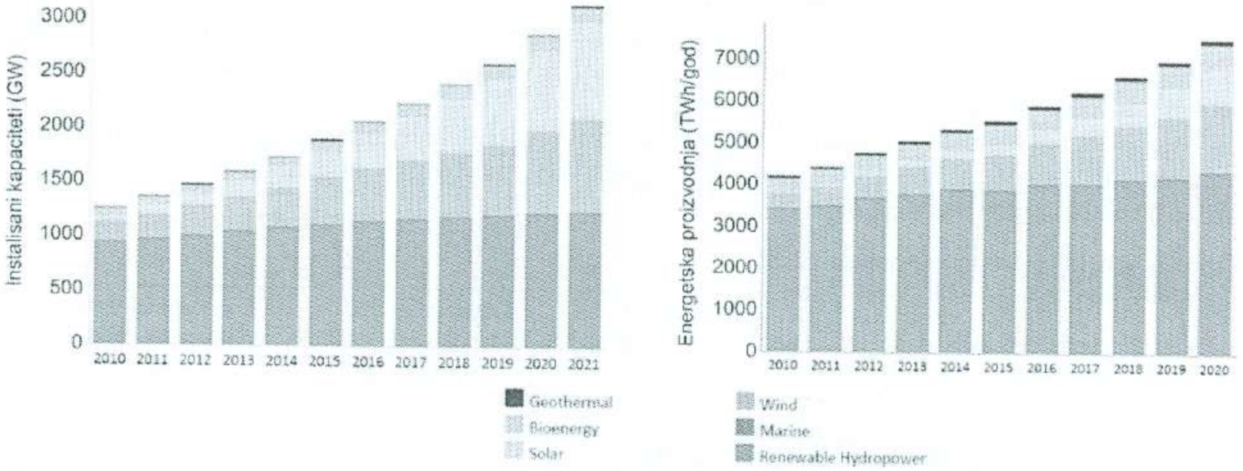

Figure 1. Total power capacity (left) and produced energy (right) from renewable energy sources [12]

If an important indicator - the impact on the stability of power systems - were taken into consideration, the assessment of some renewable energy sources (RES) would be much more unfavourable. Energy sources like wind and solar are intermittent sources (they can only be utilized when primary energy from wind and sun is available), characterized by significant variability in the available primary energy they use (transform). That variability is highly unpredictable, with almost instantaneous power increases from zero to 100% and vice versa. Both scenarios are extremely unfavourable in terms of stable and secure power system operation. As the share of energy derived from such sources increases, issues related to the management and stability of the power system becomes more complex, as well as supply security. The pronounced temporal variability of these energy sources results in two consequences: firstly, an increased necessity for units with flexible operating capability (those that can operate as spinning reserve and can rapidly cover abrupt power fluctuations); secondly, the use of such RES does not reduce the required installed capacity of other conventional power plants.

With the increase in installed capacities of wind and solar power plants, the need for hydropower plants (especially those with large reservoirs and pumped storage HPPs), that can balance their variable production, becomes more pronounced. The most important characteristics of hydropower facilities are as follows:

- they can generate electrical energy on demand, during periods when consumers need it,
- they provide peak power and energy,
- they offer spinning reserve in the EPS,
- they possess high manoeuvring capability, enabling rapid power adjustments,
- they ensure the most efficient energy conversion process. Modern facilities can convert over 95% of the flow energy into electric energy.

Reversible hydropower plants, particularly those with larger upper reservoirs, have become particularly important, as they can serve as energy storage (batteries) in EPS. When surplus energy is available, due to favourable conditions for wind and solar power plants, they operate in pumping regime, utilizing that energy for charging the upper reservoir.

3. HYDROPOWER POTENTIAL AND ITS UTILIZATION

The hydropower potential of an area is usually divided into theoretical potential, technical potential, and economically feasible potential. Theoretical potential represents the total potential that can be achieved if all the natural runoffs could be used for hydropower. Technically exploitable potential is the portion of the theoretical potential deemed feasible through appropriate technical documentation. Economically feasible potential, on the other hand, encompasses the technically exploitable potential that is financially advantageous, based on energy-economic criteria and prevailing conditions during the analysed timeframe. Technically and economically feasible potentials are dynamic indicators (they change over time) as they rely on the technical capabilities and economic landscape of water use in the given region, as well as the valuation of electric power production [2].

The global theoretical hydropower potential is estimated at around 40,470 TWh/year. The total technically feasible potential is approximately 14,322 TWh/year, while the economically feasible potential is 8,080 TWh/year (Table 1). Currently, just over 50% of the economically feasible potential has been used, but regional variations are significant. It is predominantly harnessed in North and Central America and Europe, at about 70% and 65% respectively, whereas its utilization remains lowest in Africa, accounting for less than 4%.

Table 1. World hydropower potential [5]

	Theoretical hydropower potential [TWh/god]	Technically usable hydropower potential [TWh/god]	Economically usable hydropower potential [TWh/god]
Africa	4000	1750	1000
Asia (with Russia and Turkey)	19300	6700	3600
Australia	600	270	105
Europe (without Russia and Turkey)	3220	1225	775
North and Central America	6330	1657	1000
South America	7020	2720	1600
World	**40470**	**14322**	**8080**

According to data from the International Hydropower Association (IHA) in their 2022 report, the installed capacity of HPPs is 1360 GW, generating 4,252 TWh of electricity in 2021. Around 12% of the total installed capacity consists of pumped-storage power plants, with the highest percentage in Europe, exceeding 20%, and the lowest in South America, below 1% (Figure 2). The IHA report of 2022 indicates a global count of 486 pumping stations, with 207 located in Europe alone. Among the top 10 countries are China, contributing nearly 80% (20.84 GW), followed by Canada (0.924 GW), India (0.8 GW), Nepal, Laos, Turkey (0.513 GW), and Norway (0.396 GW).

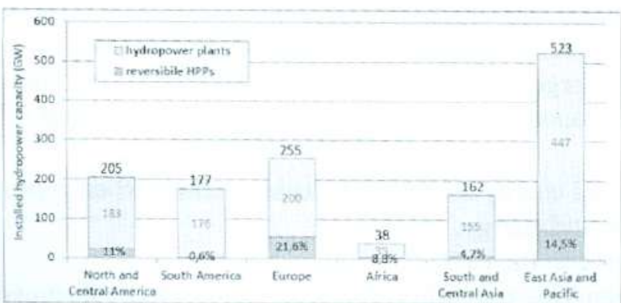

Figure 2. Total installed capacity and share of pumping plants by continent/region according to data from the International Hydropower Association [7]

Many European countries have already exploited over 70% of their hydropower potential. Leading the way are Italy, Switzerland, Spain, Germany, and Austria. Notably, significant untapped potentials remain in Turkey (approximately 100 TWh/year) and Norway (about 70 TWh/year). Turkey also falls among the group of 15 European countries that have harnessed less than 50% of their available economically usable potential. That is why it has been using it very intensively in recent years, introducing averagely 1.5 GW of newly installed capacity annually (10-year average).

The last detailed analysis of Serbia's hydropower potential was undertaken within the Water Management Plan of Serbia in 2001. According that analyses, the total gross hydropower potential is around 27.2 TWh/year. The technically usable potential amounts to approximately 19.2 TWh/year, of which about 17.5 TWh/year can be effectively utilized in facilities exceeding 10 MW. Currently, slightly less than 60% of the total technically usable potential is utilized in 16 HPPs. The average annual production is about 10.5 TWh, contributing to 28-30% of the total electricity production of JP EPS (with the highest production achieved in 2010: 12,420 GWh). The installed capacity of hydropower plants reaches 3,015 MW (Figure 3), while thermal power plants contribute 4,840 MW, resulting in hydropower plants accounting for about 38% of the total installed power within the Serbian ERS system. The challenge lies in the fact that a substantial portion of this power is generated by run-of-river hydropower plants (roughly 64%), with 15% attributed to storage HPPs, and 21% derived from reversible (pump-storage) hydropower plant RHPP Bajina Bašta.

Approximately 7.3 TWh/year of available hydropower potential remains untapped. All that potential is economically usable potential. The most significant potential (over 50%) is concentrated in two rivers: the Danube (10 TWh/year) and the Drina River (5680 TWh/year). An additional 25% is distributed across four rivers: Lim (1573 TWh/year), Velika Morava (1090 TWh/year), Ibar (998 TWh/year) and Uvac (937 TWh/year).

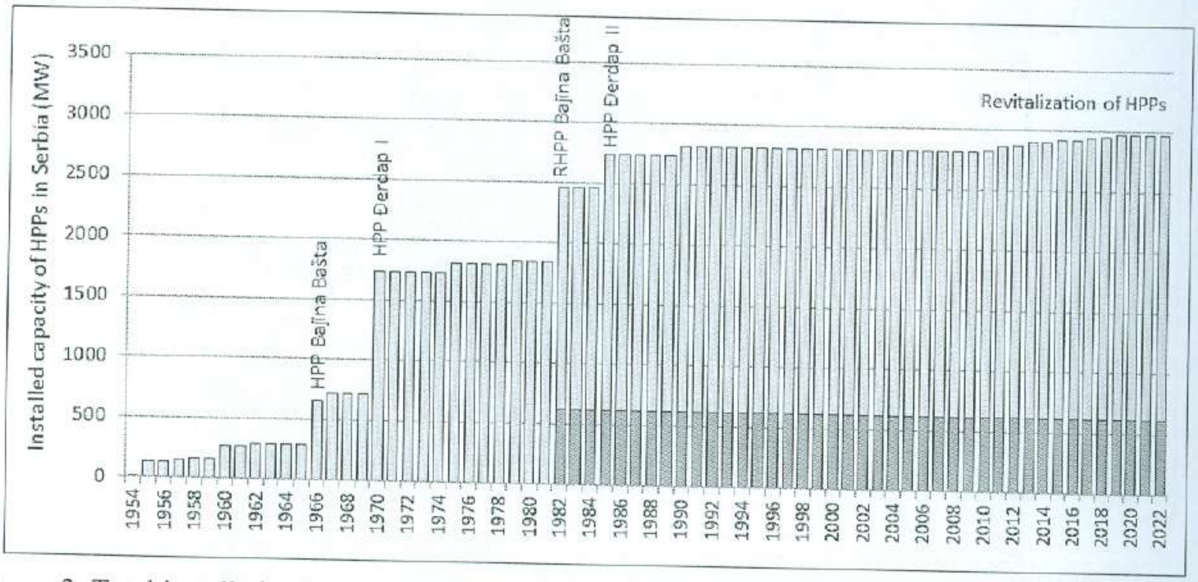

Figure 3. Total installed capacity of large hydropower plants in the Electrical Power System of Serbia

One of the most promising hydropower projects (currently in the conceptual design phase) is the RHPP Bistrica. The lower reservoir of this plant is the existing reservoir Potpeć, situated on Lim River, while the planned Klak reservoir on the Uvac River serves as the upper reservoir. Dam Klak is located 5 km downstream from the Radoinja dam (Figures 4 and 5). The initial design proposal, to merge the water of the Klak and Radoinja reservoirs, has been discarded. The main reason is the compromised (low) water quality of the Lim River, which should not be mixed with the clean water of the Radoinja reservoir, as the Radoinja reservoir serves not only for hydropower production (in HPP Bistrica) but also as a vital water supply source (for Priboj town and its surrounding). Furthermore, due to its status as a transit river originating from a neighbouring country (Montenegro), effective control over the water quality of the Lim River is unfeasible. Hence, according to the adopted solution, normal water level of the Klak reservoir maintained at a level 2 meters lower than the crest of the Radoinja dam spillway. The RHPP Bistrica utilizes a gross head of approximately 380 meters. It encompasses four reversible pump turbines, with installed capacity of 216 m³/s in turbine regime, generating a total power output of 650 MW.

4. PLACE AND ROLE OF RHPP BISTRICA IN THE ELECTRIC POWER SYSTEM OF SERBIA

The place and role of RHPP Bistrica in the electric power system of Serbia are defined by the status in the system, basic parameters of the facility, expected level of trade with other systems and placement on the stock exchange market.

Regarding the level of cycle utilization (0.713), in terms of energy, RHPP Bistrica is an energy consumer [1]. On the other hand, by its operating characteristics in turbine mode (650 MW) and active storage capacity of the reservoir (80 mil. m^3), it has properties of a flexible storage hydropower plant with the possibility of seasonal flow regulation and maximal production of variable energy.

In the electric power system, its primary role is the participation in covering of peak loads, by pumping the water from the Lim River in periods of favourable flow rates, which leads to a reduction of the required level of implementation of alternative thermal power capacities (new ones), at the expense of increased production of existing, normally older and, in terms of fuel costs, more expensive units. Given that the required level of production capacities is defined by the maximum load and level of reserves (operating and cold), the pumped-storage plant is distinguished for coverage of such demands.

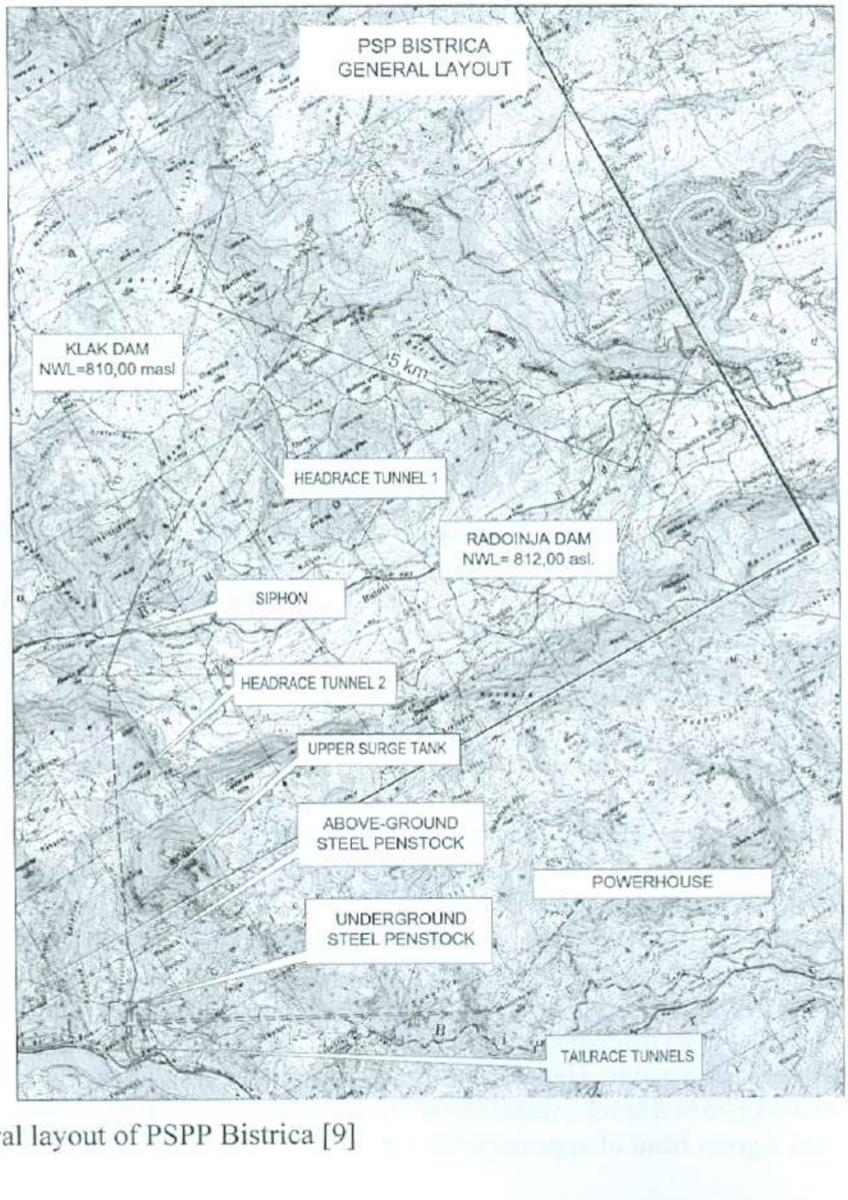

Figure 4. General layout of PSPP Bistrica [9]

By its operation, RHPP Bistrica achieves some other effects, as well, such as:

- Better utilization of RES production,
- Smaller changes in the load on thermal power units,
- Smaller share of thermal power units in the system reserve coverage,
- Monitoring of load variations during the day,
- Participation in secondary and tertiary regulation,
- Share in cold reserve coverage,
- Production of reactive energy and voltage regulation,
- Reduction of overflows resulting from the technical minimum of thermal power plants,
- A more favourable energy/power ratio for the purpose of electricity marketing, and
- Operation by the „night-day" system per elements of electricity prices in the period of low and high loads in the system.

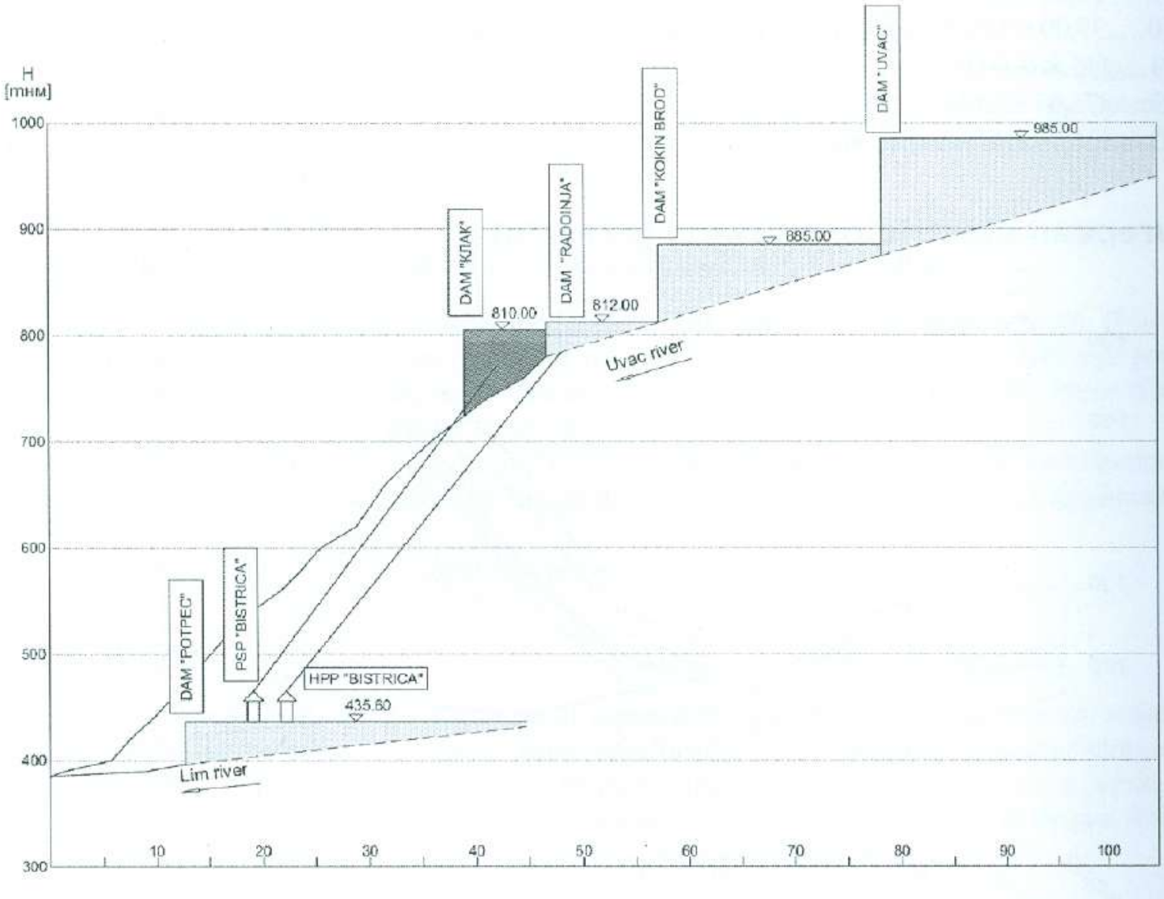

Figure 5. Schematic layout of the Lim HPP system, the Klak reservoir and the PSPP Bistrica [9]

In its primary role, RHPP Bistrica places its energy at the top of the system load diagram. In addition to energy and power placement, RHPP Bistrica participates in covering the spinning reserve of the system and in monitoring of load variations at the top of the diagram. This indicates for an expected small amount of time of use in the system, which distinguishes pumped storage plants in a system. Technologically, it may be considered that the maximum time of use (in daily regime) is 9 hours in pumping and 7 hours in turbine mode [8]. In situations when it is used as the cold reserve, the operating time during a day is not limited. Likewise, technologically, the pumping time is not limited either in periods of overflowing or high production rates of renewable energy sources.

With a view to possible cases of system status defined by hydrology, dynamics of RES production and the expected level of availability of thermal power units, two essential periods of RHPP Bistrica operation are assessed. First, the period of low water levels in rivers (those periods will be longer in conditions of climate change) that coincide with low level of RES production, is dominant from the standpoint of system dimensioning. This is normally the winter season. The second period is characterized by a sufficient level of production capacities (spring, summer) in which RHPP Bistrica is used for monitoring of the load diagram, secondary regulation, etc., and even for "night-day" operation per elements of energy prices in the period of low and high loads in the system.

Coverage of system demands based on secondary regulation, cold reserve, etc. (system needs) may be defined according to physical parameters (power, time, voltage), whereas the participation in the „day-night" regime and placement on stock exchange market largely depend on many factors which are not, or do not have to be, contingent on the situation in the system. This means that the use of this facility is based on the difference between the energy price of pumping (night) and the energy price of turbine operation (day). Electricity prices on stock exchange markets are highly variable and often depend on other than energy parameters. This is best demonstrated by the price ratio before and after 2019. Below are data of the average annual sales price taken from the HUPX stock exchange [10], as well as a diagram of price movements by month for the period Jan 2022-Jan 2023 for various European stock exchanges:

2018 51,00 €/MWh

2019 50,36 €/MWh

2020.....39,00 €/MWh (consequence of the pandemic covid 19)

2021.....113,86 €/MWh

2022.....271,65 €/MWh

2023.....110,79 €/MWh (jan-aug)

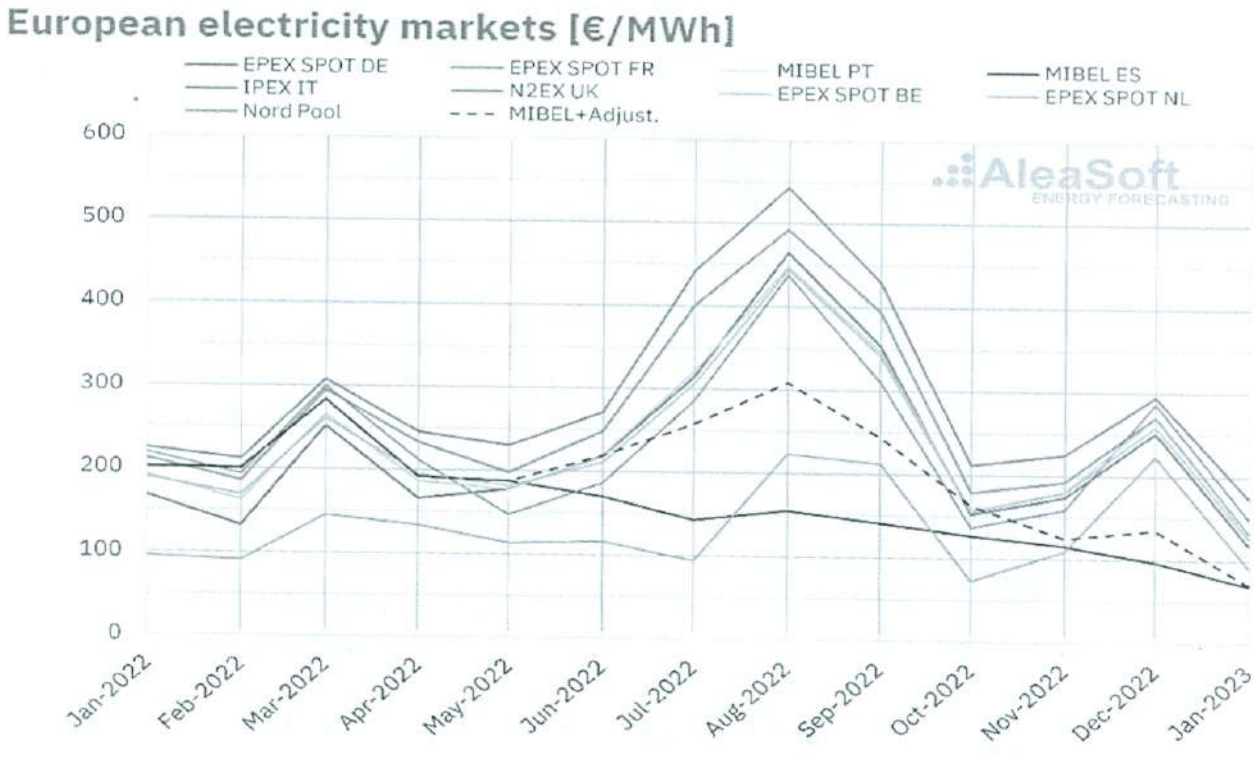

Figure 6. Electricity prices for the period Jan 2022-Jan 2023 (source [11])

4.1 IMPACT OF RHPP BISTRICA ON THE UTILIZATION LEVEL OF RES PRODUCTION

In the EPS system, in the forthcoming period, a significant increase of RES share in electricity production is expected. Figure 7 presents data for expected level of renewable energy production in Serbia, which are based on data form different studies and projects carried out within Energoprojekt – Entel [4].

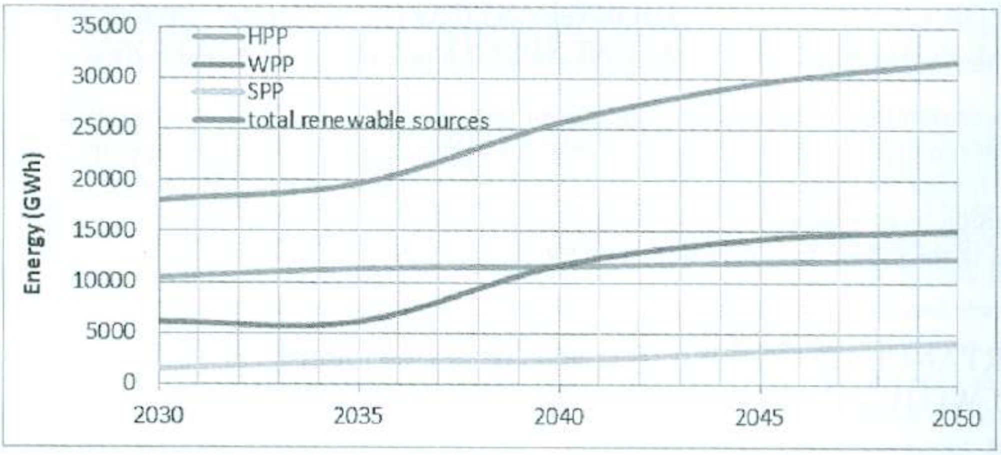

Figure 7. Expected level of renewable energy production in Serbia

The inability to regulate this production leads to an increased overflow on hydropower plants and inability to accept (spilling) of energy from RES. With introduction of RHPP Bistrica into operation (four units) in pump mode, the level of spilled and overflown energy is considerably lowered. For example, in 2035, that reduction is about 880 GWh.

4.2 USE FOR COVERAGE OF RES PRODUCTION FLUCTUATIONS

With the increase in the participation of RES, production fluctuations become more pronounced. This will require an increased scope of secondary regulation, particularly in periods of high loads. Although power plants with long headraces are not the most adequate solution for this kind of reserve, the free available power in turbine mode enables the use for these needs.

For example, in the winter months of 2035 (December, January and February), the reduction in the engagement of thermal power plants for the needs of the rotating reserve due to the engagement of RHPP Bistrica amounts to 265 MW.

Logically, total rate of power input may not exceed the available power.

4.3 "NIGHT-DAY" USE

The basic element on which the day/night use of pumped-storage plant depends, given that constant costs are defined, is the price of pumping. More specifically, this is the ratio between the price of pumping and price of turbine operation. Given the cycle utilization level (0.713), its use is justified if the ratio between the costs of pumping and turbine operation is smaller than this value. In the past period, EPS achieved significant financial benefits by this kind of RHPP Bajina Bašta utilization.

4.4 USE FOR COVERAGE OF THE COLD RESERVE OF THE SYSTEM

RHPP Bistrica avails with active storage capacity of 80 million m^3. This capacity is located high in the catchment and avails with its own head of about 350 m and about 160 m on the existing downstream facilities. With the use of one unit (175 MW, 54 m^3/s) and half the capacity (40 million m^3) for coverage of long-lasting load rejections by thermal power units, the power of 175 MW and the output of 363 GWh would be achieved on its own head. Additionally, the power of about 75 MW and the output of about 15 GWh would be achieved on downstream steps. In total, the use of one unit and half the active storage capacity (the second half is used as a reserve) substitutes 250 MW of rejected power from thermal power units during about 200 hours.

The demand for cold reserve in systems without, or with a minor share of RES, is defined by the availability of equipment in thermal power units, assuming that the presence of landfill ensures real independence from the primary energy source. In that context, the RES participation will require significantly larger reserve capacities with longer utilization duration.

4.5 USE FOR COVERAGE OF SHORT-LASTING LOAD REJECTIONS BY THERMAL POWER UNITS AND UNEXPECTED LOAD VARIATIONS

To meet these requirements, following the use of secondary regulation, it is imperative to extend the utilization of production capacities (tertiary reserve). RHPP Bistrica, even during periods of inactivity, can swiftly initiate the necessary reserve level, and in the case of an extended period of load rejection, it can transition to an operational mode that provides cold reserve for the system up to the maximum power level or the power level determined by the Klak reservoir's capacity.

5. IMPORTANCE OF CLASSIC STORAGE HYDROPOWER PLANTS IN A SYSTEM WITH A HIGH SHARE OF RES

In recent years, it appears that classic hydropower plants have been paid much less attention. This is certainly not good, either for the electric power industry or for potential investors. For that purpose, some of the preliminary analyses indicating to the complementarity of these hydropower plants with the expected putting into operation of RES, are presented.

The policy of turning to RES in order to reduce the greenhouse effect significantly increases the demand for controllable power generation sources. That energy and power may be provided by classic hydropower plants without the costs of primary energy source purchase and without special technical solutions. If they are located downstream of large, seasonal reservoirs, they may participate in provision of services in cold reserve, too. A possible concept is presented using the example of hydropower plants on the Middle Drina River.

On the stretch from Bajina Bašta to Zvornik, three hydropower plants are designed:

- Rogačica 140 MW, 525GWh,
- Srednje Tegare 125 MW, 470 GWh,
- Mala Dubravica 105 MW, 405 GWh

All the three hydropower plants can perform daily regulation of outflow, which means covering the load diagram and provision of an adequate level of power for reserve (excluding the cold reserve). The position in the watershed, however, ensures partially the use for these purposes, too, in proportion to the size of upstream seasonal reservoirs (Kokin Brod, Uvac, Piva, potentially Bijeli Brijeg, Sutjeska). In conditions of expected implementation of RES, the demand for all kinds of reserve will lead to a much higher level of utilization of installed capacity of these facilities, and the level of expected costs of fuel of gas-fuelled and classic thermal power units, of the order of magnitude from 140 to 170 €/MWh (700 €/m^3 gas and 120 €/t CO_2), will lead to a much larger annual savings on production costs.

For example, the limit value of investments for HPP Srednje Tegare (economic indicators equal to a gas-fuelled plant), with expected effects in power of the order of 90% of installed capacity and placed output of 500 GWh (470 GWh of own production + 30 GWh of overflow reduction), in relation to the same power and output of a gas-fuelled block (800 €/kW and 144 €/MWh) would be about 1050 mil. €. Preliminary analyses show that a significantly lower level of investment is to be expected for this facility, which would be reflected in significantly better economic indicators. It is similar for the other two objects.

This advantage of classic hydropower plants is a consequence of orientation towards RES, which is manifested in the level of expected gas price and fees for CO_2 emissions, as well as the characteristics of dominant RES (wind, solar) expressed through a significant availability and fluctuation of the primary energy source. In that context, it is proposed to actualize the designs of classic hydropower plants and to treat them on equal terms in the development of the productive part of the system.

6. CONCLUSION

The commitment of electric power companies to actively participate in reducing the greenhouse gasses emission (mainly CO_2) requires a more significant activation of RES and a reduction in the use of conventional solid fuel-fired thermal units. With that aim, carbon taxes have been introduced, and the prices of gas, as a potential fuel in the transition period until the implementation of "*green energy*", have been notably increased. All this, as expected, has resulted in a significant growth of production costs in alternative plants.

Extensive fluctuation of the primary energy source, the unpredictability and limited duration, alongside an outstanding inability of regulation, require adequate, complementary production capacities to ensure the expected reliability and quality of electricity. Pump-storage and classic hydropower plants capable of regulation offer these benefits. In addition to their primary function of covering peak loads, reversible power plants, as potential consumers, facilitate enhanced utilization of RES, while classic hydropower plants, given that their primary energy source is free, enable lower costs of production and also participate in the coverage of peak loads. Both pumped storage and classic hydropower plants may be used for coverage of all demands in the electric power system and, in that context, they are necessary in the process of higher activation of RES and greenhouse effect reduction. According to the expected level of costs and investment values, their economic parameters are significantly favourable compared to potential alternative solutions. This makes them recommendable for actualization of technical solutions and treatment on equal terms with other production capacities.

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