

Bulgaria's long journey from consumer to producer of energy equipment

Boyan Asparuhov

University of library studies and information technology, Sofia, Bulgaria¹

b.asparuhov@unibit.bg

Abstract: *The development of energy in our country is one of the good examples, thanks to which it can be claimed that Bulgaria is growing into an industrial country. The study of the stages in this development shows a different attitude towards this industry during the first half of the previous century and then, until the end of the socialist period. Until the middle of the century, energy was extremely underestimated as an area on which the general industrial growth depended, it was neglected financially as a secondary area, for which the differences remained from investments in other directions. A quite natural consequence of this was the weak technical training of the intelligentsia and the inability to develop its own energy production, which led to technological dependence on more developed countries. After the middle of the century, a reversal is noticeable, thanks to which the negative trends are abandoned. There are results that speak for the prioritization of energy policy.*

In addition to being singled out as a separate industry, the energy industry also robs the largest capital funds. The leading understanding is that without the development of energy, there would be no development at all. Undoubtedly, Bulgaria's great achievements in engineering, metallurgy, transport and other industrial sectors would not have been possible without the successful development of the Bulgarian energy industry.

KEYWORDS: HISTORY, ENERGY, DEVELOPMENT, MACHINE-BUILDING

1. Introduction

The industrial development of any society in the 20th century would not have been possible at all without the assimilation of technological abilities to build more powerful and more productive means to ensure higher consumer indicators in energy. Failure to understand that energy is the basis of any economy striving for industrial development condemns any society to technological backwardness. Until 1944 there is practically no energy industry in Bulgaria. The electrification known to bourgeois Bulgarian society is a technological and mechanical import, and the system is maintained and repaired by foreign specialists, mainly from Germany and Austria. In legal and regulatory terms, energy issues and problems are not considered from their own point of view, but only when solving specific issues within the competence of three separate ministries - of public works, of water and agriculture, and of mines. The Bulgarian energy industry will not have its own state department until the middle of the century. This is the reason why the idea of optimal use of water power for the production of electricity was not realized in time, although it was advocated among a small circle of people from the technical intelligentsia in Bulgaria already in the second decade of XX. After the middle of the 20th century, a real turnaround took place in our country. Gradually, the Bulgarian society grew from a consumer to a producer of the energy industry. A specific model is emerging that combines the simultaneous use of exhaustible and non-exhaustible energy sources in the production of electricity. Efforts to build highly efficient thermal power plants, even in conditions of lack of adequate raw material supply, alternate with the development of water power plants using the power of water.

2. Solutions

The socialist government inherited 127 MW of capacity installed in 121 small power plants with an annual production of 311 million kWh. This production covers the electrification needs of 13% of the total number of settlements in our country and 32% of the population. These indicators rank our country in the penultimate place in Europe at the end of the World War II. [1] The data reveal a very low level of energy development, and the production based on foreign projects, imported technologies and machines is grossly insufficient to meet the energy needs of the Bulgarian society, both for domestic consumption and for the development of other industrial branches. The reason for this lag is the lack of an adequate regulatory framework to regulate the development of the energy sector and the absence of unified management. Only in 1928 a separate department of electricity was created under the umbrella of the Ministry of Public Works, although the Society of Engineers and Architects had declared itself the sole legislation and management of the sector a full decade earlier. [2]

In 1929 by order of the Minister of Agriculture and State Properties, D. Hristov, a commission was appointed to draw up a general plan for electrification of the country, using its thermal and hydraulic resources. This commission sat until 1933 without achieving its goals, and the electrification plan was not completed until the 1950s. [ibid]

Only in 1946 the government in its program statement announces that special attention will be devoted to the rapid overcoming of the energy supply crisis by building a comprehensive electrification system based on powerful steam and water plants. [3]

With the establishment of the Ministry of Electrification in 1946, and the Law on Electricity Industry adopted by the National Assembly in 1948 begins the successive construction of a more powerful energy base to overcome the economic backwardness of our country. Increasing the production of existing plants and building new energy capacities are the two main directions of the new energy policy. [1,p.372]

The facilities and the energy base with which Bulgaria crossed the first half of the 20th century are morally outdated and extremely insufficient for the needs of the new industrial development. Our most powerful thermal power plant, left as a legacy from the period before 1944 - the one in the village of Kurilo - reached 14.5 mW, and most of the others were below 1 mW. In 1948, its power was increased to 18 mW. In 1951 and 1955 expansions were carried out at the Pernik TPP, the V. Kolarov", TPP "Yanko Kostov", etc., new diesel generators have also been installed in Northern Bulgaria. At the same time, new thermal power plants are being built - TPP Sofia, TPP "Republika" in Pernik, TPP "Maritsa 3" in Dimitrovgrad. By the mid-1950s, electricity production increased 7 times compared to 1944. [ibid]

This shows that the needs characteristic of the industrial growth of a society have already become inherent in the Bulgarian economy. The registered higher production of electricity gives confidence for setting more distant goals, such as the policy for accelerated economic development of Bulgaria. In a report of the Committee on Industry to the Council of Ministers, delivered in 1960 the need for additional construction of 1 million kilowatts of electric power by 1970 is substantiated. [4] Data from the current consumption of electricity are indicated and a forecast is made for future needs. In 1959 the annual consumption was 3.895 billion kWh. In 15 years, consumption has increased 12 and a half times. It is planned that in 1962 the consumption will reach nearly 8 billion kWh, and in 1970 - 22 - 24 billion kWh. [ibid]

A reference to the data of the Central Statistical Office shows that in 1970 the electricity produced was 19.5 billion kWh, and the consumption was 15 billion kWh.[5] Regardless of the fact that the planned figures were not reached in the desired period, the increase in electricity consumption in our country was a permanent trend until 1989, although a decrease in growth was noticed after 1975, due to the gradual transition to a more economical and efficient use

of energy resources. In order to satisfy the ever-growing needs for electrical energy, the construction of production facilities, which has not been undertaken until now, is underway. In 1960, the first large thermal power plant in our country, Maritsa Iztok 1 (TPP MI 1), was put into operation. In order to reach its planned capacity of 500-550 mW, 8 turbo units with a total capacity of 800 mW were delivered from the USSR in succession, of which 4 pcs. 50 mW and 4 units of 150 mW. (two for TPP MI 1 and two for TPP MI 2).[6]

Powers of such a scale in the energy sector were not known in our country so far. Only TPP MI 1 could generate more electricity than all power plants put together to date! With its commissioning, it suddenly turns out that only one new plant increases energy efficiency. This is a technological step forward for the Bulgarian energy industry, a new level of production, promising unlimited consumption and removal of restrictions for further industrial development. This positive amplitude was most noticeable in the decade between 1950 and 1960. The total installed power capacity at the beginning of this decade was 176 mW, and at the end - 929 mW. New capacities were then introduced, providing an additional 730 MW, or 79% of all existing capacities were newly built and equipped with modern equipment. [7] In this case, we observe, on the one hand, the utilization of much more powerful technical facilities, having greater energy indicators, operating at much higher parameters (only one of the two turbounits in TPP MI 1, which has a power of 150 mW, exceeded the entire power generated by all power plants combined from the time until 1944!) On the other hand, there is a new technological moment - construction, through consolidation - 4 turbo units of 50 mW and two more of 150 mW. - united in one headquarters. The consolidation of production facilities and separate units, as a result of which higher indicators have been reached, is a sign that Bulgaria is becoming part of the world's technical progress.

The MI1 TPP emerged as the largest source in our power system and remained a major producer until the mid-1960s, when the first unit of the new MI2 TPP was commissioned. Until 1968 three more units of 150 mW each come into operation and the new plant adds another 600 mW to the national energy system. TPP MI 2 reaches a higher power at the very first stage of its construction and operates with 4 turbine units of 150 mW each. In addition, the newly built capacities, although with greater energy indicators and parameters, create opportunities to reduce fuel costs. (ibid)

Probably the biggest achievement of all is the creation of our own base for the development of energy construction. In fact, the construction of the large thermal power plants in the Marishka basin was realized according to technical projects prepared in the USSR, but Bulgarian engineers participated in their preparation. In a report to the Secretariat of the BKP, the director of Energoproekt reports that in our country hydrotechnical objects, power lines, substations, factory thermal plants and the construction-constructive part of large thermal plants are independently designed. Only the machine-technological and electrical parts of the thermal power plants with medium and large power are not designed independently. [8]

But the report draws attention to the possibility that their design could begin to be carried out entirely by Energoproekt, which would significantly reduce investment costs. Then it was also noted that the benefits of independent design would be complemented by the effect of adopting more economical solutions when solving technical and constructive issues, according to our conditions. (ibid) At a meeting of the Electricity Commission held in Leningrad in May 1963, the needs of the countries (from Eastern Europe) for equipment were determined and recommendations were made for specialization in production. Our nomenclature includes the main thermal power equipment - steam turbine units, steam boiler units and turbogenerators. We insist that the electromechanical equipment - synchronous compensators, capacitors and cables - be included there. The Bulgarian delegate Huben Ovcharov reports that the production of auxiliary equipment, which is expensive, requires a lot of labor and few materials, which our country can benefit from. [8, p.29]

Until 1980 the production of electrical energy from thermal power plants is developed as a priority, because of their high productivity,

although this is not a sufficient motive. Bulgaria's energy policy for the period is guided by the principle of building such capacities that use local primary energy resources as fuel, which unfortunately turn out to be extremely insufficient.

By the middle of the 1950s, quality coal was exhausted and the use of low-calorie lignite coal from the Eastern Mariskie basin began, which until that moment had not been used as a raw material for combustion in general practice worldwide, due to its poor qualities. Bulgaria was the first to start using them for energy purposes by constructing devices for their more efficient burning. [1,p.373]

In 1964, Bulgarian-Soviet studies were launched to establish a scheme for burning coal in the new TPP MI 3, which has a total capacity of 840 MW. The boiler unit of the power plant, constructed entirely by Bulgarian Research Institute of Energy [9], works according to the scheme launched by engineer N. Todoriev for direct burning of lignite coal, significantly reducing the costs of building facilities for drying the fuel raw material. This scheme proved its advantages and in 1980 was also introduced in TPP MI 2. [1, p.550]

The "Maritsa - East" complex is shaping up to be the most powerful center of thermal power plants in our country. Characteristic of the development of thermal power plants is the significant concentration of production capacities. In 1950 the average power was 4.4 mW, in 1960 it increased to 100 mW and reached 1260 mW in 1980. [ibid]

In parallel with the expansion and construction of new thermal power plants, the hydro potential of Bulgaria was also developing. In the master plan for electrification, realized in the 1950s, hydroelectric plants were given a primary role. By 1945 in our country there were several hydroelectric power plants with running water with a total installed capacity of 47 MW. In 1948, the Energohydroproject was established, which began research and design of future sites

The following year, the Hidrostroy administration was created, which was entrusted with the construction. After many years of activity related to geological, hydrological, topographic, etc. studies of the rivers in our country, in 1956 the country's hydropower potential has been determined. [1, p. 374]

Given the natural circumstances, the construction of long collecting derivations and numerous water intakes began according to original solutions. The goal is maximum utilization of the high falls in the mountainous regions. [ibid]

The decade between 1950 and 1960 it turned out to be particularly strong for the development of hydropower. Large dams "Stalin", "Batak" and the power plants connected to them "Batak", "Peshtera", "Aleko", "Pasarel", "Kokaliane" and others were put into operation. In 1960 75 units have already been built in our country. hydroelectric plants and the first 11 large dams were built, the main purpose of which was the production of electricity. [10]

What strongly distinguishes Bulgarian energy before the middle of the century from the period after is the inclusion of our country in the production of energy equipment. Until 1944 the energy base such as facilities, projects and installation was the work of foreign companies and foreign technical personnel. [1, p. 371]

In his book with memories of electrification before September 9, engineer Teodor Tsonev summarizes that the German-oriented policy of our government before 1944 rested on the basis that Bulgaria should not develop industrially, but should remain a faithful producer and supplier of agricultural products attached to the highly developed German industry. [2, p. 245]

The state of consumption was interrupted in the middle of the century to begin a new stage - of building the production of energy equipment. Our own production of energy equipment for hydroelectric power plants began in 1952. Then the engineers I. Pehlivanov, V. Konstantinov and A. Nikolov started the water turbine project for the Batoshevo 2 HPP (3 turbines x 6.6 mW) and the Studena HPP (2 turbines x 3.7 mW). In a few months, the constructions were completed, and in 1 year they were made in DMZ N. Vaptsarov, Pleven.

Meanwhile, the cast iron spirals and flywheels with a unit weight of 1 ton came out ready from the first casting, and the working wheels

were cast by the chief engineer of the "Electrometal" steel foundry in Sofia VI. Dimitrov. According to the project, they should have been made of bronze, but Dimitrov experimented and made a casting from the classic chrome-nickel stainless steel with the necessary physical and mechanical properties. So, in 1956 Bulgaria is included in the list of energy equipment manufacturers. [11] In 1958, China ordered 30 sets of turbogenerators from Energohydroproject. The value of the contract was \$50 million. For three years, the Bulgarian plants have been working on the implementation of this order, and Bulgaria was included in the list of energy equipment exporters. [ibid]

In 1959 by decree of the Ministry of Justice No. 1368 of 20.8.1959, the "Antonivanovtsi" hydroelectric junction was included for construction during the third five-year plan. The rainbow dam that was built is the highest in the Balkans - 144 m, with a crown length of 440 m and a reservoir volume of 218 million cubic meters. The conceptual design of the dam was subjected to a model static-mechanical study in Italy and proved to be correctly designed. [12]

In 1959 one of the most important hydropower projects in our country has been completed - the Batashkiy hydropower road. In essence, it is a cascade between two main dams and three power plants located on them with a total power of 232 MW. In 1965 "Arda" cascade with a total power of 277 mW was also completed. [1p. 374]

Compared to those built before 1944 water plants with capacities well below 1 MW, these engineering projects impress with their scale and are testimony to the technological transition that Bulgarian society made.

In the period 1950-60 the unified high-voltage system was built and the main part of the electrification of the settlements was completed. During this period, 2,200 km of high voltage, 13,000 m of medium voltage and 21,200 low voltage networks were built. [7]

Until 1965 in our country we created (designed and built) water turbines, their shut-off devices and generators for 14 HPPs. There are 24 hydro units in operation in these HPPs, with a total capacity of about 50 mW. This number does not include the 32 hydro units and their facilities exported to China, and later to Vietnam, with a total capacity of 46.6 MW. In this period, the maximum power of the unit achieved was 7.5 mW. [13]

In DMZ "N. Vaptsarov", Pleven, and in STZ "V. Kolarov", Sofia using models and technical assistance from Soviet specialists, our engineers construct the turbines for the hydro facilities in a local production environment. The regulators and part of the automation elements remain imported, but for the rest a complete production environment is being developed in our country. Initially, this was done without the presence of a hydraulic laboratory, which led to some design flaws affecting the quality, the price of the machines and the delivery times. In terms of efficiency, our machines are at an average level, in terms of speed they are inferior to those produced in the West. [ibid]

In 1967 the turbines, equipment and generators for another 9 HPPs with a total capacity of 349 MW are in production or in the process of construction. The maximum achieved power of one unit is already 62 MW - Momina Klisura HPP [ibid]

The factory in Pleven was already working on the production of turbines with a maximum weight of the processed parts of 70 tons, and in STZ "V. Kolarov" in Sofia, 8 units were produced. Synchronous generators with a total weight of 670 tons and 663 synchronous and asynchronous motors over 100 kW with a total weight of 1264 tons. The equipment allows the processing of single parts up to 40 tons. [ibid]

The planned in 1960 construction of new means of energy production, which would satisfy the ever-increasing needs of electricity consumption, was ahead of schedule by 2 years, being implemented as early as 1968 and exceeding the additional 1,000 mW capacity indicated by the Planning Committee as necessary. In 1970, the total power reached only by the thermal power plants was 3300 mW, and by hydropower plants 816 mW [5]

The desire to continuously increase electricity production continues to grow in the next decade. The master plan for hydropower construction of the Ministry of Energy and Fuels envisages

construction by 1980 on new 37 medium and large HPPs, on various small HPPs and on 6 pumped storage HPPs. (PAVEC)[13] It is planned to install 85 units of three different types - Francis, Pelton and Kaplan - with a total capacity of 2,700 MW in the medium and large plants. The value of the turbine part amounts to BGN 57 million, of the generators – BGN 67 million, or a total of BGN 124 million. BGN 40 million are additional expenses for the hydro units of the PAVEC. In order to save BGN 164 million in costs to the state budget, expansion of the turbopumping workshop at DMZ N. Vaptsarov, Pleven, construction of a generator workshop at STZ V. Kolarov, Sofia, and construction of a test laboratory for researching model water turbines were planned. [ibid]

Only the units of the Belmeken HPP and the Sestrimo HPP are planned for import due to the insufficient preparation (as of 1967) for the production of large turbines and generators, but despite this, negotiations are underway to manufacture part of the equipment in our country according to the company's construction documentation provider [ibid]

In the period 1960-1970, in connection with the intensive development of the energy-intensive branches of industry, mechanized agriculture, transport and the household, the need for electricity increased. The need is also reinforced by insufficient efficiency in the use of resources, by the structure and quality of raw materials. [1, p.548]

In the following decade - 1970-1980 - the growth of energy consumption gradually decreased, since the material base of the Bulgarian industry was already built to a considerable extent and it gradually moved to less energy-intensive productions. Nevertheless, the targeted rates of economic and social development cannot be achieved by maintaining the rate of import of energy resources.

The development of electricity production is oriented towards nuclear energy. With the signing of a cooperation agreement with the USSR in 1966, the construction of a nuclear power plant near Kozloduy began, which was built in three stages till 1990-es with a total planned capacity of 3760 MW.

Conclusion

Bulgaria's way of energy development keeps pace with world trends, draws on the rich technological experience of developed Western countries and uses the help of Soviet specialists. In 1988, the power generation capacities in our country were nearly 80 times more, and the power generation 145 times greater than in 1944. [1,p.548]

This giant technological step, although it does not look so impressive against the background of the general energy development on a planetary scale, but it impresses above all with the desire to create our own base for the design and construction of energy plants, with the development of state production of energy equipment, of technical and scientific potential, which ennobles Bulgarian society and creates conditions for its transition from an agrarian to an industrial environment.

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