RESEARCH ON THE DAILY DURATION OF ELECTRICITY PRODUCTION FROM RENEWABLE SOURCES – MAIN FACTOR FOR THEIR EFFICIENCY

*Kamen Seymenliyski**

I. Introduction

The European Union (EU) aims to be a world leader in the fight against climate change and in this regard seeks to achieve the objectives in agreement with the United Nations Framework Convention on Climate Change (COP 21) in Paris, while ensuring clean energy throughout the Union.

To fulfil this commitment, the EU has set the following binding climate and energytargets for 2030 as follows:

EU climate and energy targets for 2030

▪ Reduction of greenhouse gas emissions (NG) by at least 40% compared to 1990..;

▪ Increase the share of energy from renewable sources (VI) to at least 32% of gross final energy consumption in the EU;

▪ Ensuring a minimum of 15% grid interconnection between Member States;

▪ Increase energy efficiency (EE) to at least 32.5%.

Bulgaria's Strategy related to the Five Dimensions of the Energy Union

In line with the EU's priorities for increasing energy efficiency, Bulgaria puts energy efficiency first, given its importance for improving the country's energy security by reducing dependence on energy imports [1,2,3,4].

National targets have been set to achieve a 27.89% reduction in primary energy consumption and a 31.67% reduction in final energy consumption by 2030 compared to the PRIMES 2007 reference scenario. In order to meet these objectives, effective technologies need to be used to absorb the resource from renewable energy sources [5,6,7,8].

The subject of this article is an analysis of the technological implementation of these objectives in the context of investments in BG energy and the resulting disproportions. Proposals have also been made to correct negative trends. When fulfilling all stages of the EU's objectives in BG, RES based on climate-dependent technology are built as a priority.

II. Enquiry into the lifetime of renewable energy sources

In the last 10years Bulgaria's installed capacity from photovoltaic power plants has increased by about 1000 MW and installed power from wind power plants has increased by 400 MW. All this creates a problem maintaining the daily balance of the energy system. At daylight, when production from photovoltaic power plants increases production from systemic energy sources must be reduced, or this energy needs to be accumulated so we have available electricity consumption corresponding to that production. To propose a solution to these problems, the authors examined the daily duration and the exact daily recurrence period of such production in different seasons. Seeking seasonal dependence to the duration of these productions, authors strive to provide for the possibilities for the construction of consuming or accumulating facilities, as well as the export of electricity within these time ranges [8,9,10].

A survey of an existing photovoltaic plant in south-eastern Bulgaria with installed capacity 100kWp was carried out. The data obtained from the survey is presented in Fig. 1 and fig. 2.

* Kamen Seymenliyski
Burgas Free University

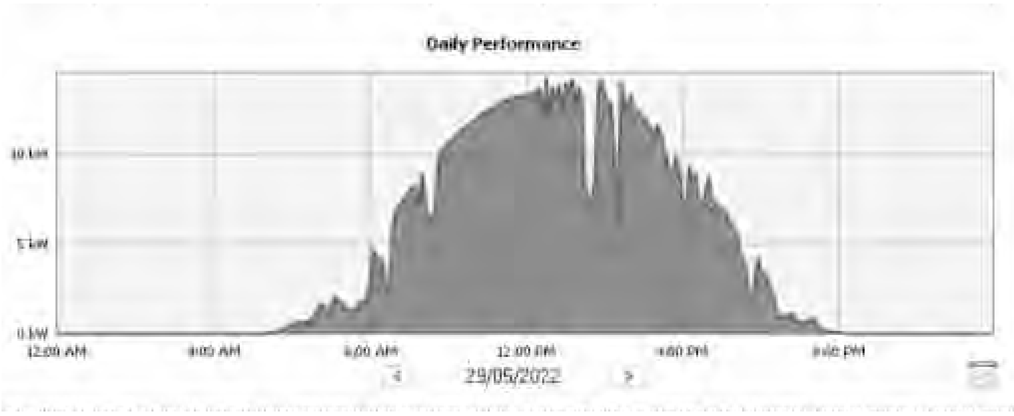

Figure 1 – Daily electricity extraction profile from the PV plant examined

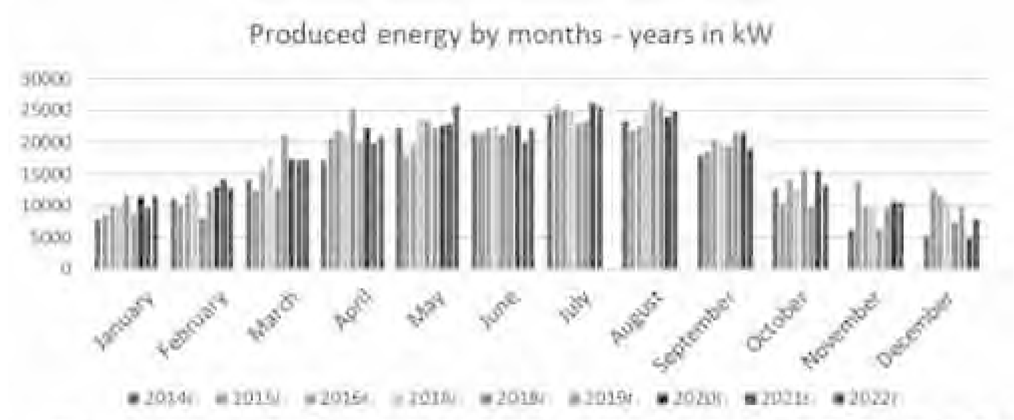

Figure 2 – Data from commercial measurement methods of the amount of energy produced and returned to the grid by month in years

These findings indicate that time and climatic variables have a significant impact on the final output. The findings and yield during the research period indicate that the climatic characteristics of each individual year have only minor variations over time. Research has demonstrated that hourly and meteorological elements have a significant impact on the harvesting of electrical power [11,12,13].

Energy storage or, to a lesser extent, installing solar panels in different directions during installation are two ways to lengthen the time that photovoltaic plants may run. On Fig.3 and fig. 4 are presented in graphic form the results of a study for the beginning and end of operation of a photovoltaic panel made of monocrystalline technology at a slope of 90°; 33°; 15° and 0 ° relative to the earth's surface for the months from May to September.

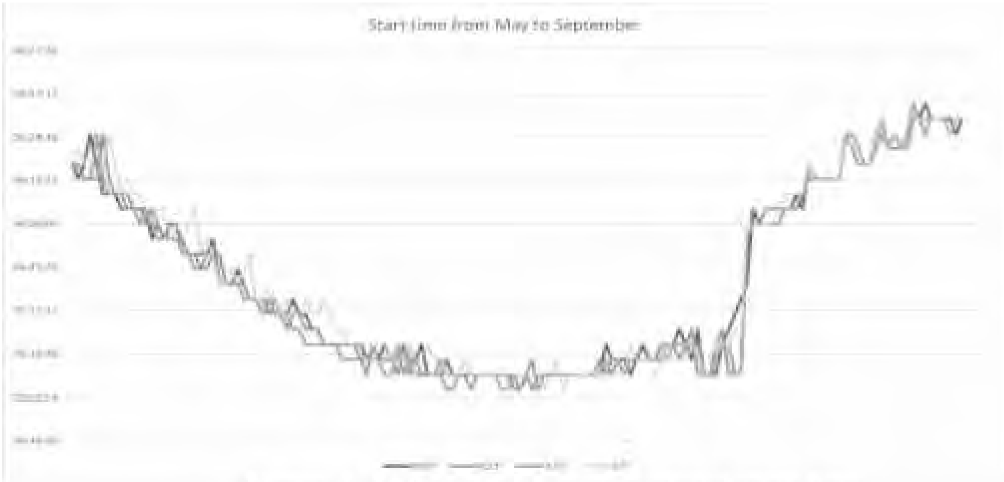

Figure 3 – Change in the generational start time

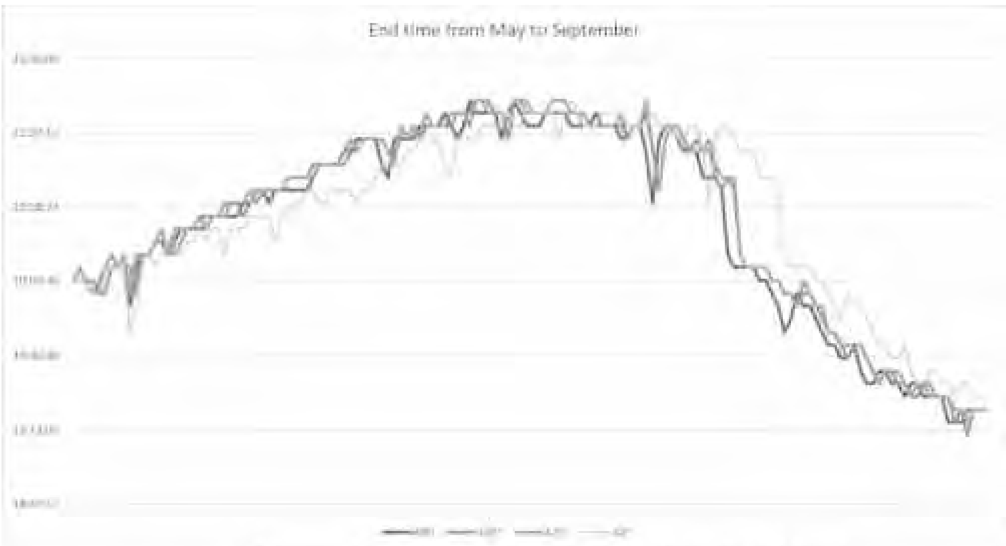

Figure 4 – Change in the generational end time

Fig. 5 displays survey results for particular days. These show that the angle at which the same cells are distributed greatly influences the amount of energy extracted.

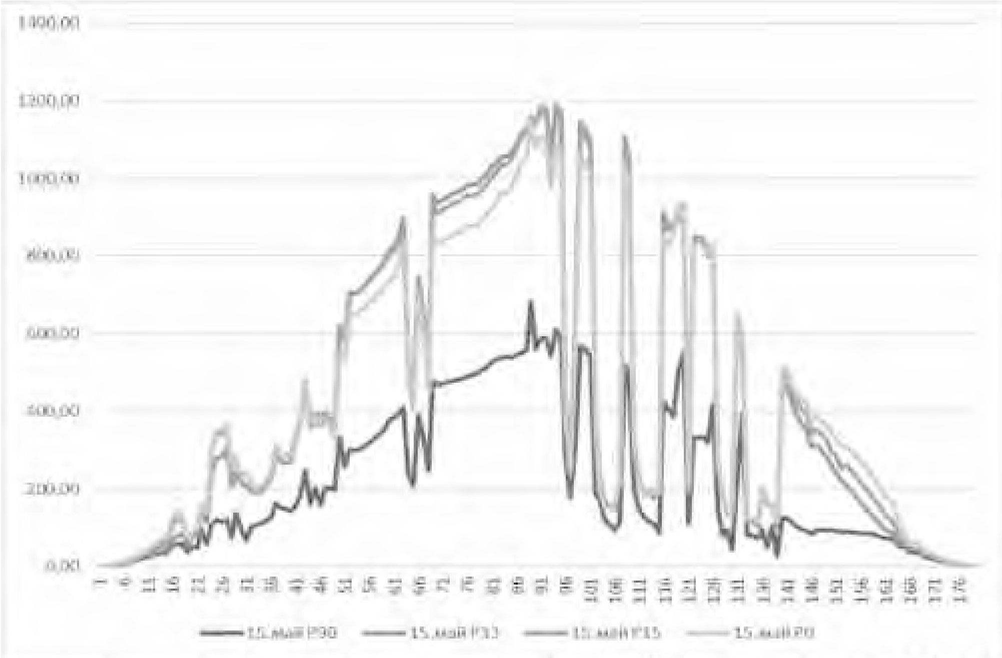

Figure 5 - Graph of energy production at different gradient for May 15

III. Solar plants connected to ESO

The same indicators were examined nationally. Fig. 6 presents the results obtained for the initial, final generation time of all photovoltaic plants connected to the ESO, as well as the average duration of operation.

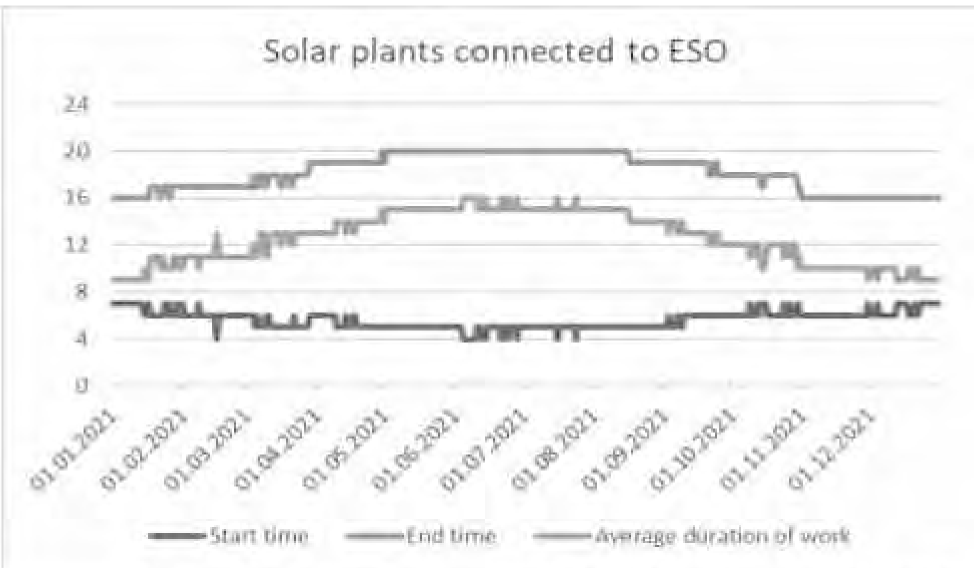

Figure 6 – Time parameters of solar plants connected to ESO

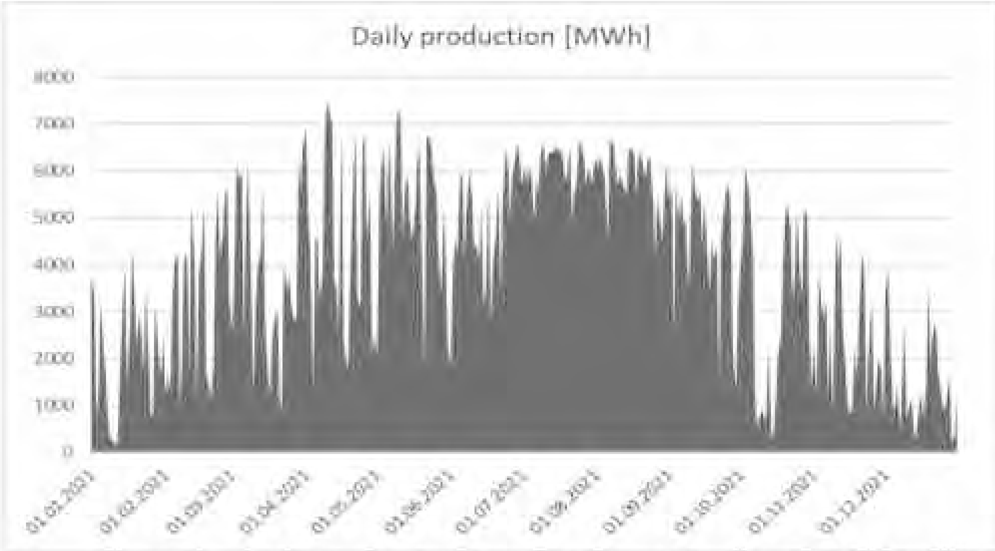

Figure 7 – Daily production from PV plants joined to the ESO in MWh.

Fig. 8 presents the dependency of daily electricity generation in MWh for a calendar year.

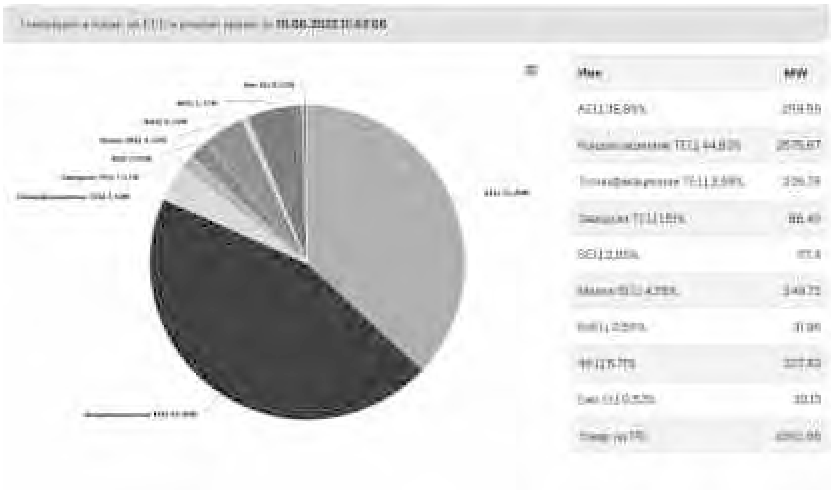

Figure 8 – Daily generation of electricity by type

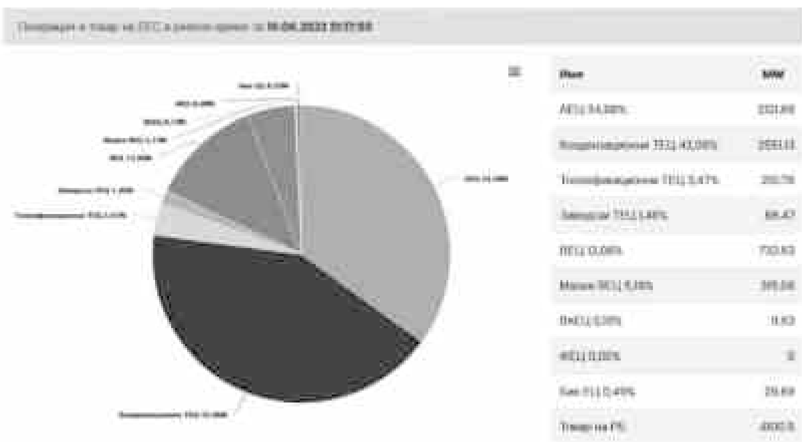

Figure 9 – Night generation of electricity by type

The trends studied are even more visible from the diagrams presented in Fig. 8 and Fig. 9. It is evident that a growing portion of the energy generated by photovoltaic plants, as a percentage of total production, is lost during the night hours. The resources in Bulgaria's energy system still exist allowing the generation of electricity from hydropower plants to take it's place in this segment [14,15].

IV. Conclusion

Numerous issues arise for Bulgaria's energy system as a result of the increased rate of photovoltaic facilities joining the energy system as a priority. Because all are climate and time dependent, as evidenced by the studies, they inject energy into the grid for a short period. This energy cannot always be regulated because it is affected by constantly changing environmental factors.

The construction of large facilities far from settlements is becoming increasingly inefficient, resulting in a process of transporting large amounts of electricity over long distances suffering immense losses.

The construction of small facilities near the consumer solves this problem to some extent.

In the event of a we have a small production capacity close to a consumer, the majority of the energy produced from this power can be consumed immediately by consumers who have been specially designed to do so in a timely manner and as a matter of priority.

Building such small flexible facilities in the vicinity of a consumer as a priority can prevent a number of problems in the national energy system caused by the chaotic accession of photovoltaic plants to parts of the energy system that are not suitable for this purpose.

Another approach to solving these problems is the construction of large centralised or small decentralised storage facilities to act as a buffer in balancing the energy system.

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