

OPINION

for dissertation work

for the acquisition of the educational and scientific degree "doctor" in field of higher education – 5. Technical sciences

professional direction - 5.2. Electrical engineering, electronics and automation

doctoral program - Power supply and electrical equipment

Author: Mag. Elisabetta Traiko Arsova, Eng

Topic: Analysis of the possibilities for implementing new photovoltaic power plants in the electricity system of the Republic of North Macedonia

Member of the scientific jury: Assoc. Prof. Dr. Eng. Iliyan Hristov Iliev

1. Topic and relevance of the dissertation

In recent years, the traditional production of electricity from conventional energy sources has been the largest source of industrial air pollution. Air quality deterioration, global warming data, as well as periodic local energy crises require a transition to new primary energy sources that do not pollute the environment and provide additional opportunities to increase energy independence.

In line with these current trends, the present dissertation includes a study and analysis of the electric power capacities in North Macedonia, as well as an assessment of the production after the construction of large new photovoltaic power plants Oslomei - 2 FEC with an installed capacity of up to 20 MW and Bitola FEC with an installed capacity of up to 40 MW. With the construction of the photovoltaic power plants FEC Oslomei - 2 and FEC Bitola, the relative share of electricity produced from renewable sources will increase in relation to the total electricity produced, as well as in the total consumption of electricity. By increasing the installed capacity from renewable energy sources, the European Union's green energy directives will be met, which will lead to a reduction in air pollution. This will be of great benefit both to the energy sector in the Republic of North Macedonia and to its citizens.

2. Research methodology

In order to achieve the goal and tasks of the dissertation work, methods, two software products and an online product PVGIS were used. A methodology for researching the potential for electricity production from photovoltaic power plants and their modeling and simulation of operation is presented. The software products PVGIS and PVsyst were selected for the implementation of the methodology, presenting their capabilities and functions, from the application of which the following can be concluded:

1. The online PVGIS tool is convenient and free to use. It facilitates the way of performing a preliminary analysis of photovoltaic power plant projects by providing a database of the level of solar radiation and other meteorological and topographical indicators that are necessary to assess the potential for the production of electrical energy in a given geographic location.
2. PVGIS provides information on solar radiation in all parts of the world, including the territory of the Republic of North Macedonia, by calculating the expected electricity production, as with it the expected electricity production can be simulated for daily, monthly and annual level. The display of the results can be visually graphical and tabular.

3. Both software products provide a choice for the application of photovoltaic panels with different technologies, as in PVsyst there is an up-to-date database with detailed technical data of specific models of photovoltaic modules of a large number of manufacturers available on the market.
4. Both softwares provide the possibility of calculations of different panel placement angles as well as different orientation location. In this way, optimal calculations can be made for the production of electricity from photovoltaic plants for the specific location.
5. It is possible to carry out technical and economic calculations to assess the profitability of the investments for the construction of the photovoltaic power plant.

3. Contributions of the dissertation

I accept the doctoral student's formulated contributions to the dissertation work. They are related to the analysis of the possibilities for the implementation of new photovoltaic power plants in the electricity system of the Republic of North Macedonia. The contributions have a scientific-applied and applied character.

Scientific-applied contributions:

1. As a result of the detailed analytical study of the balance of electricity production and, in particular, of photovoltaic power plants in 4 countries on the Balkan Peninsula - the Republic of North Macedonia, Bulgaria, Serbia and Croatia, reasoned recommendations have been made for the construction of new photovoltaic power plants in the Republic of North Macedonia.
2. A model of the electric power system of the Republic of North Macedonia has been synthesized, enabling the analysis of changes in energy flows, energy losses and over-voltages in the power grid when connecting the newly designed photovoltaic power plants.

Applied Contributions:

1. The potential of solar radiation for the production of electrical energy from photovoltaic power plants on the territory of the Republic of North Macedonia was investigated.
2. Detailed variant projects of 2 photovoltaic plants on the territory of the Republic of North Macedonia with a total capacity of 60 MWp have been developed, using 4 different variants of technologies and orientation of the photovoltaic modules.
3. A technical-economic analysis and evaluation of the profitability of the construction of the new 2 photovoltaic power plants on the territory of the Republic of North Macedonia has been made, taking into account the dependence on the expected prices on the electricity market in the coming years.

4. Publications and quotations of publications on the dissertation work

The author has a total of five publications related to the dissertation, of which two are independent, two are with the researcher and their supervisor and one is in co-authorship, published on the following forums:

1. Arsov B., Arsova E., Sadinov S., Measurements of the non-ionizing radiation of 5G base station of mobile operator Makedonski Telekom AD Skopje and electricity supply with photovoltaic plant, EEPES.EU, International Conference on Electronics, Engineering, Physics and Earth Science, EEPES 2023 Conference, Scopus (ID144, page 19), Kavala, Greece, June

2023 (Indexing and Publishing AIP Conference Proceedings is indexing in: Scopus, CPCI (part of Web of Science), Inspec index, SJR 0.19) (in Print)

2. Arsova E., Expansion of renewable energy sources in 2022 in the RN Macedonia, 7th International Scientific Conference – TechCo 2023, June 2023, Technical College Lovech –

3. Arsova E., Electricity crisis in 2021 in the RN Macedonia and recommendations for the future, 7th International Scientific Conference – TechCo 2023, June 2023, Technical College Lovech –

4. Arsova E., Tsankov P., Implementation of 40 MW photovoltaic power plant Bitola in RN Macedonia, International Scientific Conference UNITECH 2023, November 2023, Technical

5. Arsova E., Tsankov P., Design of 20 MW Photovoltaic power plant Oslomej in RN Macedonia, International Scientific Conference UNITECH 2023, November 2023, Technical

The publication activity is reflected to the maximum extent in the dissertation work.

5. Authorship of the obtained results

I believe that the obtained results of the scientific research and the presented dissertation work are the author's development of the doctoral student under the scientific and methodological guidance of her supervisor.

6. Opinions, recommendations and remarks on the dissertation work

I have no significant remarks on the dissertation work. The recommendations and remarks made by me during the development and presentation of the dissertation are generally reflected by the doctoral student.

I would recommend the work on the topic to continue, suggesting that the doctoral student publishes a monograph on the topic.

7. Conclusion

I believe that the submitted dissertation meets the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria. The results achieved give me the reason to propose the acquisition of the educational and scientific degree "doctor"

from Mag. Elisabetta Traiko Arsova, Eng

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Signature:.....

/Assoc. Prof. Phd Eng. Iliyan Iliev/