

OPINION

for dissertation work

**to obtain of the educational and scientific degree "Doctor" in
field of Higher Education – 5. Technical Sciences,**

**Vocational field 5.2. Electrical, electronic and automation engineering,
Doctoral Program “Power Supply and Electrical Equipment”**

Author: MSc Engineer Elisabetta Traiko Arsova,

**Topic: Feasibility Study for the Implementation of New Photovoltaic Power Plants in the
Electricity System of the Republic of North Macedonia.**

Member of the Scientific Jury: Assoc. Prof. PhD Dimitrina Yordanova Koeva

1. Topic and relevance of the thesis

Each country has its own strategic policies and regulations dealing with market liberalization and decarbonization plans according to climatic, economic, geopolitical and other factors. Electricity distribution grids, in particular, have undergone a radical transformation by an ever-increasing amount of variable and distributed renewable generation. The power sector will be more involved in the evolution of the electricity system towards future smart grid scenarios, where active grids will be able to integrate renewable energy sources (RES) in response to increased end-user demand and energy storage systems (ESS). The combination of renewables and storage is the key to decarbonization.

The transition of electricity system management from centralized to decentralized models is also a very topical issue for many countries in Europe, including the Republic of North Macedonia. The future development of an energy system will require the use of a large share of renewable energy sources, high adaptability and adequate distribution of energy flows in order to achieve a reliable and cost-effective electricity supply. In order to ensure a cost-effective, secure, reliable and sustainable electricity supply, it is necessary to conduct a detailed analysis of the country's energy balance, generation capacity trends, energy prices and other key indicators closely related to the economic and geopolitical situation in the Republic of North Macedonia. The thesis deals with these issues in detail.

All this leads to the conclusion that the developed thesis is relevant in both scientific and applied aspects and contributes to solving problems and issues related to the potential of solar power plants as decentralized energy sources and their impact on the sustainability of the energy system of the Republic of North Macedonia (RNM).

2. Research methodology

The objectives of the dissertation have been reached through the use of modern methods and technical tools to design, simulate, model and optimize with specialized software.

Based on the methodology and the selection of a suitable web-based interface of the PVGIS software, the stimulation study of the solar irradiation potential for electricity generation in RNM was carried out. This was followed by a preliminary selection of important quantities and parameters for two new PV power plants: the Oslomey-2 PV power plant (20

MW) and the Bitola PV power plant (40 MW). The exact location and PV technology, installed peak power, system losses, installation position, PV module tilt and azimuth were selected.

The impact of the two new PV PPs on the country's energy mix will be assessed on a seasonal and annual basis following simulation studies and comparative analysis.

Following the simulation studies, a techno-economic assessment was made and the energy efficiency after the application of this new scenario for the power system of the Republic of North Macedonia was evaluated.

3. Contributions of the dissertation

I accept the contributions of the dissertation work formulated by the doctoral candidate and define them as scientifically applied and applied.

Scientific-applied contributions

- The construction of two new PV PPs was justified by a detailed analysis of RNM's energy exchanges with neighboring countries.
- The energy losses and overvoltages at the connection points of the new decentralized PV PPs will be determined in a modelling study.

Applied contributions

- Project proposals under different PV technology options and orientations were developed for two new PV power plants in the territory of RNM: Osloimey - 2 (20 MW) and Bitola PV power plant (40 MW).
- Techno-economic analysis of project options implementation was prepared, taking into account their impact on the country's energy mix and electricity price.

4. Publications and citations of publications of the dissertation

The doctoral candidate has attached a list of 5 publications to her thesis. The main results of the thesis have been published in 4 publications, all at conferences in our country. There are 2 independent publications, [A2, A3], and 2 publications co-authored with her scientific supervisor, [A4, A5]. One publication, [A1], with impact rank (SJR 0.19) was presented at an international conference abroad.

There are also 8 publications from the period 2013-2015, before the doctoral student was enrolled, which only indicate past publication activity and competence on energy markets at RNM.

Total score for Indicator "I" - **73.33 points**, which significantly exceeds the requirement of **30 points**. Publications citing information was not provided.

5. Authorship of the obtained results

The obtained results of the scientific research and the presented dissertation I define as the author's work under the scientific and methodological guidance of her supervisor.

6. Opinions, recommendations and comments on the doctoral thesis

To the submitted thesis, I have the following comments and recommendations of a technical nature:

1. Misspelling in the statement.
2. The list of abbreviations should be more precise and complete.

3. Some of the units, used to denote quantities and parameters are not in the SI system.

4. It is recommended that the bibliography be arranged as required. Only 65 of the 139 listed references are cited. The remaining 74 are not cited: [2, 4, 15-21, 24, 25, 28, 29, 37, 40, 49, 51, 53, 62, 63, 75-89, 90, 93, 96-109, 114-118, 120-125, 127-135, 137-139].

The recommendations and comments do not affect the development. They can be easily deleted from the electronic version of the thesis, and the abstract deposited in the National Centre for Information and Documentation of the Republic of Bulgaria.

7. Conclusion

I believe that the submitted dissertation **meets the requirements** of the Law on the Development of Academic Staff in the Republic of Bulgaria. The achieved results give me a reason **to propose** that the educational and scientific degree "Doctor" be acquired from the MSc. Eng. Elizabeta Trajko Arsova,

From the field of Higher Education – 5. Technical Sciences,

Vocational field 5.2. Electrical, electronic and automation engineering,

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20.03.2024

Signed:/signature/.....

/ Assoc. Prof. PhD Dimitrina Koeva /