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STATEMENT

by Prof. Dr. Miglena Zhiyanski
member of the scientific jury, determined by Order No.506/10.07.2026 r. of the Rector of UACG

regarding: dissertation thesis of eng. Bisera [redacted] Ivanova on the topic "Ecological approach to spatial planning in renewable energy projects", submitted for the acquisition of the educational and scientific degree "PhD" in professional field 5.7. "Architecture, construction and geodesy", scientific specialty "Land development and protection of agricultural lands (incl. property management)"

Bisera Biserova Ivanova has a master's degree in "Geodesy" from the University of Architecture, Construction and Geodesy (UACG), and her professional and academic development is directly related to the topic of the presented dissertation work. After graduating in 2020, she works as a software developer, where she applies her knowledge in the field of spatial data and three-dimensional modeling. Since 2021, she has been a doctoral student, and since 2022, an assistant professor at UACG, teaching in disciplines in the field of spatial planning, land and property management, ecology and geodesy. Along with her academic work, she has practical experience in the development of general and detailed spatial plans, which complements her professional profile and is directly related to the scientific issues of the dissertation. According to the submitted documents, the doctoral student meets the minimum national requirements for acquiring the educational and scientific degree "PhD", declaring a total of 100 points with a minimum required of 80 points - 50 points for group A indicators for the dissertation work and 50 points for group D indicators, formed by three scientific publications on the topic of the research. A declaration of originality is also submitted, in which the doctoral student declares the independent nature of the development, compliance with copyright requirements and that the dissertation has not been submitted to another institution for the acquisition of an educational and scientific degree.
When reviewing the documentation, I found a technical inconsistency in the Declaration of Compliance with Minimum National Requirements, where in one place the title "Soil-climatic assessment when building vineyards for white table wines" is indicated, which does not correspond to the dissertation submitted for defense. In the same document, immediately after, the topic "Ecological approach to spatial planning in energy projects from renewable sources" is correctly indicated. I accept this as an obvious technical error, which should be corrected in the documentation of the procedure and does not affect my assessment of the scientific qualities of the dissertation and the fulfillment of the minimum national requirements.

1. GENERAL CHARACTERISTICS AND RELEVANCE OF THE THESIS

The dissertation thesis of eng. Bisera Biserova Ivanova submitted for statement is developed in a total volume of 168 pages, including the main text, appendices, used bibliographical sources and a list of publications related to the dissertation research. The main presentation is developed to page 123, after which the appendices, references and publications on the topic of the dissertation are presented. The work is illustrated with 10 figures and 12 tables, which present the conceptual and methodological schemes, the models used, the territorial alternatives and the main results of the study.

The bibliographical basis includes 135 sources, supplemented by independently presented sources of spatial and statistical data. Scientific publications, strategic and regulatory documents, European and international sources, as well as modern developments in the field of renewable energy, land use, ecosystem services, multi-criteria analysis and spatial planning have been used. This shows a good knowledge of the state of the research problem and allows it to be placed in the modern national and European context.

I find the volume of the dissertation work adequate to the set goals and objectives, and the structure - logical and well-balanced between the theoretical-analytical, methodological and applied parts.

The topic of the dissertation thesis is topical and of clearly expressed scientific and practical significance. The accelerated development of renewable energy sources and in particular of ground-based photovoltaic power plants is an essential component of European and national policies for decarbonization and climate neutrality. Along with the undeniable benefits of the energy transition, however, the growing demand for territories for the construction of thermal power plants gives rise to competition between different forms of land use and raises issues related to the protection of agricultural lands, soil resources, biodiversity, landscape and ecosystem functions.

The problem posed in the dissertation about the need for better integration of energy, environmental and spatial planning aspects is particularly relevant. The author rightly notes that scientific research is largely concentrated on the economic and technical aspects of the ecological aspects of the development of RES, while issues related to spatial planning, land use and the resulting environmental conflicts remain relatively less studied.

With the accelerated development of the PVPP, the traditional assessment of individual investment intentions does not always allow for adequate consideration of the cumulative spatial and environmental effects. Therefore, the search for an approach through which the ecological characteristics and limitations of the territory can be included at the level of general spatial planning is timely and practically necessary.

In this context, the choice of topic is appropriate and directly corresponds to the scientific specialty "Land Development and Protection of Agricultural Land (incl. Property Management)".

2. EVALUATION OF THE STRUCTURE, METHODOLOGY AND MAIN RESULTS

The goal, object and subject of the study are clearly formulated, and the six tasks set outline a consistent path for its implementation - from the analysis of the political and regulatory framework and existing practices to the development, testing and evaluation of one's own methodological approach.

The methodology is one of the strengths of the dissertation. The study combines documentary and comparative analysis, work with spatial data and GIS, an ecosystem approach, the concept of ecosystem services, the DPSIR framework, multi-criteria analysis using the Analytic Hierarchy Process (AHP) and aggregation of results using an integrated environmental sustainability index (ESI).

This combination of approaches is appropriate for the nature of the problem under study, as it allows it to be considered not only from the point of view of the regulatory and technical admissibility of investment intentions, but as a complex spatial and environmental problem.

I positively assess the use of DPSIR not simply as a descriptive framework, but as a means of structuring the cause-and-effect relationships between the development of the PVPP, the pressure on agricultural lands and natural components, changes in the state of the

environment and the necessary management responses. Subsequently, these relationships were transformed into a system of criteria and sub-criteria included in the multi-criteria model.

The developed methodological guidelines are structured in nine consecutive stages, covering preliminary territorial eligibility, DPSIR analysis, determination and weighting of criteria, valuation and normalization of indicators and calculation of the final integrated index. Such a structure gives the methodology good traceability and potential for practical application.

A significant merit of the dissertation work is the testing of the methodology on real territories in the municipalities of Radnevo and Rakitovo. The selection of two municipalities with significantly different natural, spatial and economic characteristics allows to evaluate the behavior of the methodology under different conditions. Spatial processing and analysis were performed in a QGIS environment, with the spatial data used being pre-processed and brought to a single coordinate system.

The obtained results allow for the differentiation and ranking of the studied territorial alternatives and show that the methodology can function as a tool for supporting decisions at the level of general spatial planning.

I also positively assess the author's effort to take the analysis beyond the purely technical or regulatory admissibility of a given territory. The proposed framework includes spatial, soil-ecological, hydro-ecological, biotic, landscape and microclimatic characteristics, which is in accordance with the stated integrated ecological approach.

3. SCIENTIFIC AND SCIENTIFIC-APPLIED CONTRIBUTIONS

I accept the main contributions formulated in the dissertation, and I would highlight the following:

A systematized analysis of the interaction and potential conflicts between the development of photovoltaic energy, spatial planning and the protection of agricultural lands has been carried out, with the problem being considered simultaneously from its regulatory, spatial and ecological perspective.

An integrated methodological framework has been developed in which DPSIR, AHP and a system of ecological and spatial criteria are linked in a consistent algorithm for preliminary assessment and selection of territorial alternatives for the construction of a photovoltaic power plant.

A system of criteria, sub-criteria and indicators has been created and an integrated environmental sustainability index (ESI) has been applied for aggregation and comparison of the obtained assessments.

The proposed approach has been tested on real territorial alternatives, which has demonstrated the possibility of its practical application.

As a significant scientific and applied result, the proposals for improving spatial planning should also be highlighted, including the proposed variant of a production spatial planning zone for the production and storage of electricity from RES - Ppe, as well as the related spatial rules and norms.

Overall, I believe that the contributions are predominantly scientific and applied, which is completely natural given the topic and professional The direction of the dissertation. They are expressed mainly in the integration and adaptation of established analytical approaches to the specific problem of spatial planning of PVPP on agricultural lands and in their transformation into a practically applicable algorithm for assessment.

4. CRITICAL NOTES AND RECOMMENDATIONS

Along with the positive assessment of the dissertation work, I would like to make a few remarks that do not question the achieved results, but rather outline some methodological limitations and opportunities for future development of the research.

First of all, although the ecosystem approach and ecosystem services are an important part of the conceptual basis of the work, the relationship between specific changes in land use, the state of ecosystems and the change in the provided ecosystem services could be developed more explicitly in the quantitative part of the assessment. This would strengthen the ecological component of the proposed integrated model and would allow for a more direct accounting of the potential benefits and losses from the change in the purpose of agricultural lands.

Secondly, the application of AHP inevitably involves an element of expert subjectivity. The author takes the necessary steps to limit it by using independent expert assessments and checking their consistency. Nevertheless, in future development of the methodology, it would be useful to study to a greater extent the influence of the composition and professional profile of the expert group on the resulting weights and the final ranking. A comparison between the results obtained by different expert groups or when including a wider range of stakeholders would provide additional information on the sustainability of the model.

I note that testing in two municipalities with contrasting characteristics is appropriate for proving the principle applicability of the methodology, but still represents a limited basis for assessing its universality. Its application to a larger number of territories characterized by different investment pressure, agricultural potential, nature conservation status and land use structure would allow a more reliable assessment of its sustainability and transferability.

Although the ESI integrated index is a tool for summarizing and comparing results, mathematically it is based on a weighted aggregation of normalized indicators. Therefore, I believe that the original contribution should be sought primarily in the specific structuring, parameterization and application of the index for the purposes of ecologically oriented spatial planning, and not so much in the mathematical principle of its construction itself.

The sensitivity analysis could also be expanded in future development of the approach by more systematically varying the weights, using alternative normalization schemes and possibly comparing it with other multi-criteria analysis methods. This would allow assessing the extent to which the final ranking is preserved not only when individual input values change, but also when some of the methodological assumptions change.

The proposed maximum value of 20% for soil sealing deserves special attention. It is positive that the author himself presents it as indicative and takes into account the need for additional interdisciplinary research. Given the differences in the designs of the FPP, the types of soils, the relief and the method of construction of the service infrastructure, I believe that before such a value is used as a normative threshold, it should receive a broader empirical justification.

The above notes are primarily recommendations for future development and upgrading of the developed approach and do not reduce the quality and contribution of the presented dissertation work.

5. PUBLICATIONS ON THE DISSERTATION THESIS

Three publications have been presented on the topic of the dissertation thesis - two independent publications by Bissera Ivanova in the journal "Geodesy, Cartography, Land Management" from 2024 and 2025 and one publication co-authored with L. Stoyanov in the

proceedings of the XVII International Scientific Conference "E-Governance and E-Communications", related to the balance between the development of renewable energy and the sustainable use of agricultural land in Bulgaria.
The publications thematically reflect the main components of the dissertation research and show consistency in the development and presentation of the results to the scientific and professional community.

6. QUESTIONS TO THE DOCTORAL STUDENT
In connection with the presented dissertation thesis, I would like to ask the following questions:
1. To what extent do you think the obtained ranking of the territorial alternatives is stable to changes in the expert weights of the criteria? If the methodology is applied by another expert group with a different professional composition, which criteria do you expect to have the most significant impact on the final result and how would you check the stability of the ranking?
2. How would you develop the proposed methodology so that ecosystem services are more directly and quantitatively included in the final ESI? Which ecosystem services do you consider to be most sensitive in the transformation of agricultural lands for the construction of a PVPP and is it possible for their change to be used as an independent criterion in the selection of territories?
I believe that these questions would allow the public defense to discuss not only the developed methodology in its current form, but also its sustainability, applicability and potential for future development.

7. CONCLUSION
The dissertation thesis of eng. Bisera Biserova Ivanova represents an independent, complete and up-to-date scientific study with a clearly expressed scientific and applied focus. The set goal has been achieved, and the formulated research tasks have been fulfilled.
As the main merits of the work, I assess the relevance and practical significance of the research problem, the interdisciplinary nature of the approach, the consistent integration of spatial and ecological criteria, the use of DPSIR and multi-criteria analysis, the testing on real territorial alternatives and the aspiration to transform the results into practically applicable solutions for spatial planning.
The critical remarks made are primarily related to the possibilities for broader validation, quantitative development and future upgrading of the methodology and do not change my overall positive assessment of the dissertation work.
The presented results and scientific and applied contributions give me reason to believe that the dissertation work meets the requirements for acquiring the educational and scientific degree "doctor".
Based on the above, I give a POSITIVE EVALUATION of the dissertation work and will confidently vote for the award of the educational and scientific degree "doctor" to Eng. Bisera [redacted] Ivanova in the professional field 5.7. "Architecture, Construction and Geodesy", scientific specialty "Land Management and Conservation of Agricultural Lands (incl. Property Management)".

Date: 24/08/2026

Member of the Scientific Jury: .....

Miglena Kircheva Zhiyanski

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