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## R e v i e w

PhD thesis of MA Feyruz Mustafayeva p.t. "**The potential role of renewable energy in providing energy security of Azerbaijan**" prepared under the scientific guidance of Dr. hab. Przemysław Kulawczuk, professor of the University of Gdańsk

### **Justification for the choice of topic and set-up of the work**

According to the reviewer, the subject of the doctoral dissertation by Mr. Feyruz Mustafayev titled "The potential role of renewable energy in providing energy security in Azerbaijan" is an attempt to reformulate the country's economic policy by substituting oil and gas with renewable energy sources in order to ensure Azerbaijan's long-term energy security. Even if this objective is not explicitly stated anywhere in the dissertation, it can be inferred from reading the dissertation in its entirety. Furthermore, this topic can be seen as being part of the very important issue of the sustainable development of the world economy. Sustainable development "...strives to define the economic conditions that would ensure sufficiently high ecological, economic and socio-cultural standards for all people living now and for future generations within the limits of nature's tolerance, thus implementing the principle of intra-generational and intergenerational equity...". The concept above logically frames the issue of renewable energy and energy security as a particular approach to the issue of sustainable development. This dissertation however, does not define the concept of renewable energy as an energy source that almost does not cause any exhaustion of the renewable resources and releases relatively few harmful substances throughout its life cycle. This corresponds roughly to the principles of the economy of sustainable development.

Generally, the reviewed work does not contain any reference to the theoretical underpinnings of the problem being the subject of the dissertation. As a result, this work is actually a monograph discussing the subject in an exhaustive and original way. The exhaustive nature of the work is manifested in its thematic coherence, and its originality. Azerbaijan, as a

sovereign country, has existed on the international scene since October 18, 1991. Therefore, all information about the country, especially detailed knowledge as contained in the reviewed work, constitutes an originally new area, especially in the case of Polish literature.

Without this information, it is difficult to understand why Azerbaijan has problems with energy security, since its current known oil resources are estimated to be sufficient for 24 years, and gas for 117 years (p. 6). However, taking into account that its energy products constitute 40% of its gross domestic product and 90% of its exports, it seems that the PhD student's awareness of the need to increase the country's competitiveness through the development of sectors of the economy other than fuel and energy was the basis for undertaking the subject of the thesis. The basis for enabling this migration towards new sources of economic growth can and should still for a long time come from the revenues generated by the domestic oil and gas sector. Over time, gradually we should observe the substitution of the energy sector with supplies from renewable energy sources.

## **Objective and hypotheses of work**

In light of the above remarks, the objective of the dissertation is understandable and substantively justified. It aims to examine the potential contribution of renewable energy sources, mainly in the field of wind and solar energy, towards increasing the energy security of Azerbaijan (p. 7). In order to achieve this objective, the author has distinguished a cognitive and a practical goal. He defined the cognitive goal as an attempt to present the impact of renewable energy sources on the country's energy security, while the practical goal was to identify the advantages and disadvantages of these sources and their potential impact on the economy of Azerbaijan. The prospective context of both specific objectives clearly suggests that the dissertation was prepared with a view to shaping the future economic policy of this country and proposing future structural changes to the Azeri energy sector. A logical supplement to the objective of the dissertation is a research hypothesis, which should be understood as a conjecture or a provisional guess to determine or explain something that needs to be investigated through appropriate research. In the case of the reviewed work, one hypothesis was put forward, i.e. "...the development of the renewable energy sector, supported by the growing share of electricity coming from low emission sources, can significantly strengthen the energy security of Azerbaijan and have a positive effect on the economy...".

This hypothesis is supplemented by four research questions that specify it further:

- What is the current state of development of the renewable energy sector in Azerbaijan?
- What is the current state of Azerbaijan's energy security?
- Can renewable energy sources strengthen Azerbaijan's energy security?
- What are the financial and economic consequences of the development of the renewable energy sector in Azerbaijan?

In light of the above, I consider the choice of the topic of work to be appropriate. The hypothesis and research questions logical are also justified, especially in relation to Azerbaijan. They are broadly formulated and cover a wide range of topics, which indicates the descriptive nature of the work.

### **Assessment of the research method**

In order to conduct empirical analysis and test the hypothesis and formulate answers to the research questions, the PhD student adopted a particular approach. It was based on the use of several well-known models allowing to assess the level of Azerbaijan's energy security, such as:

- The International Energy Agency Model of Short-term Energy Security
- International Institute for Applied System Analysis Global Energy Assessment Model
- Winzers methodology of energy security assessment framework.

The choice of this approach is justified by the PhD student by referring to the limitations faced in the availability and accessing relevant data. At the same time, he is not aware that by looking at how renewable energy is used in six selected countries and in the European Union in order to find the most appropriate solutions for Azerbaijan, he in fact using the well-known method of benchmarking. The technical shortcomings of the research side of the work seem to be the main reason why the dissertation remains consistently descriptive.

### **Presentation and content of the work**

The presentation of the work is determined by the goal, hypothesis and research questions that form a coherent whole and are reflected in the layout of the dissertation. The importance of the research undertaken is justified by the doctoral student by the relatively

limited experience of the country in conducting independent economic policy and with the key importance of energy security for the future of the country. The latter should be part of the design and investment process and the project's profitability.

The work presented for review contains 202 numbered pages. It consists of 6 substantive chapters, an abstract, an introduction, a literature list and a list of charts, tables and illustrations.

**Chapter I** "The historical role of hydrocarbon resources in the development of the Azerbaijan economy", which is 28 pages long, presents the chronological role of oil in the development of the present territory of the country from 1818, but especially from the country's political independence in 1991 to 2019. It emphasizes the growing importance of gas resources to the economy. This chapter considers the current state of energy security, including hydrocarbons. It is based on detailed historical data from original sources. The chapter therefore remains descriptive. It is factually correct as it is based on historical data. The chapter does not contain own assessments and conclusions that could be useful for shaping economic policy.

**Chapter II** is devoted to the presentation of the current state of production of energy from renewable sources and the assessment of their potential future role. When referring to future developments, only the prospects for the production of renewable energy from wind and solar are discussed. In this chapter, similarly to the previous one, the author presented the issues thoroughly, using interesting factual material.

**Chapter III** is devoted to research (in fact presentation) of the best international practices of introducing renewable energy sources into the energy systems of 6 selected countries: Norway, Austria, Portugal, Romania, Croatia and Greece. From the point of view of Azerbaijan, the choice of these countries as a point of reference / benchmark is appropriate. When analysing individual countries, the author focused on:

- the already installed potential of renewable energy sources,
- the relationship between renewable and hydrocarbon resources in energy production,
- legal, political and economic regulations supporting the process of sourcing energy.

This relatively long chapter (37 pages) is similar to the previous two. Surprisingly, this chapter contains a section 3.5, titled 'Conclusions', which is 2 pages long. This is a controversial approach, especially since the work as a whole does not contain a summary/ concluding section. This chapter is based on the use of the benchmarking method, i.e. the method of equating the best or using the best formulas in a given activity. Benchmarking allows to determine whether

and how the production process or other functions performed by the organization should be undertaken or improved. The process consists of five steps, where the next step is to find other organizations that are doing similar activities and are doing them well. In turn, measurements should be made that, through their consistent analysis, will help explain how these organizations achieve such good results. You can then undertake measures that initiate or improve the development of the skills of the leaders of this organization and its members. In this chapter, the doctoral student gives the impression that he was not aware of the existence the method of benchmarking, despite the fact that he actually carried out the first three steps of this research method.

**Chapter IV**, titled "Azerbaijan's Use of Selected Best International Practices" is, in fact, the next step in the benchmarking method, which is to identify the legal regulations and solutions used to support the creation of renewable energy sources. The regulations of the European Union and the already mentioned six countries which serve as the point of reference are thoroughly discussed (section 4.1). Against this background, the current state of regulation in Azerbaijan is presented, and then the opportunities for applying these identified, best international practices to improve the regulatory framework in Azerbaijan is considered.

**In chapter V**, the author focused on the assessment of the potential of renewable energy sources in the country, especially in relation to wind and solar energy and their contribution to the development of Azerbaijan's economy. The importance of future energy storage is correctly underlined here. Unfortunately Sections 5.3 and 5.4 are relatively short and total only 6 pages. The editorial form of this chapter contains many detailed calculations and mathematical formulas. Their accuracy is difficult to verify, and the chapter itself resembles a report prepared by or for an agency / government of Azerbaijan.

It is difficult to assess the shortest (only 18 pages) **Chapter VI**, devoted to the transition of Azerbaijan's economy to the use of renewable energy sources and the impact this process could have on the economy of this country. In this chapter there is a 4-page subsection 6.3 titled "Recommendations" with 7 generally valid recommendations. This section could form the basis for writing a typical conclusion to a dissertation. The recommendations themselves are formulated in a way that suggests that they are not original conclusions stemming from the PhD student's own research, but can rather be attributed to specific knowledge of hard-to-reach national and international assessments and studies. The content of the first two subchapters 6.1 and 6.2 would easily enrich the content of the previous chapters. This would benefit the internal consistency of the doctoral dissertation and its editorial appropriateness.

Summing up the research findings of the PhD student, I can say that he has proved the relevance of including renewable energy sources in building Azerbaijan's long-term energy security. Thus, the hypothesis of the dissertation was successfully verified empirically. However, a doctoral dissertation in the field of economic sciences should include empirical research of a macroeconomic nature. The doctoral student hints at such research in subsection 6.2 titled "Expected added value from the use of renewable energy sources for the economy of Azerbaijan" (B.J.), which is only 8 pages long. At the beginning of that section, however, he states that such research in this country has never been carried out so far (p. 169). Hence, the PhD student uses the data of specialized international organizations such as the International Renewable Energy Agency (IRENA) based in Abu Dhabi. IRENA helps analysts, decision makers and the public to make informed decisions in this area of study. The area of interest of this organization also includes Azerbaijan. Such argumentation is possible and credible, but it diminishes the author's original contribution to the dissertation.

The less significant flaws include a number of editorial errors, such as not starting chapters I and VI from a new page, missing conclusions, or failing to specify a date for accessing particular internet sources. This last remark is connected with the assessment of the literature used in the work. It contains 285 items, almost entirely from sources on the Internet. All items are in English. Moreover, the work contains 34 tables, 30 charts and 19 illustrations. They are all prepared carefully, legibly and aesthetically.

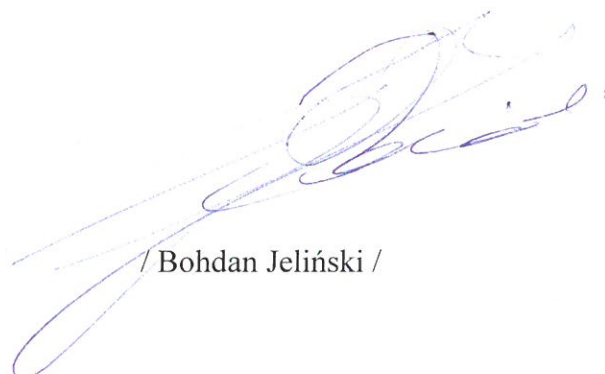
### **Final grade**

Taking into account the full substantive content and interdisciplinary nature of the reviewed work, I would like to state that it is ambitious and interesting, as well as up-to-date and practically useful - especially in relation to Azerbaijan. It is a valuable study, written with a deep and professional knowledge of the subject, which is still poorly researched in Azerbaijani and Polish literature. I also believe that, despite the previously raised critical remarks, the main goal and other partial tasks formulated in the introduction to the dissertation have largely been accomplished. This proves the PhD student's extensive knowledge and skills in the complex field of creation and application of renewable energy sources.

In conclusion, taking into account the novelty and practical usefulness, as well as the complexity and importance of the subject matter for the future economic development of

Azerbaijan, I believe that the doctoral dissertation of Mr. Feyruz Mustafayeva meets the requirements for doctoral theses and I am recommending its admission for public defense.

Gdynia, May 23<sup>rd</sup>, 2022

A handwritten signature in blue ink, appearing to be 'Bohdan Jeliński', written in a cursive style.

/ Bohdan Jeliński /