A new method for assessing sustainable energy management

The problem of renewable energy sources (RES) is characterized by high complexity in the existence of many different, often conflicting criteria that need to be considered in the analysis and evaluation. This approach requires the use of multi-criteria decision support methods (MCDA) that give a possibility to increase the influence of the analyst in the evaluation process, modification of the criteria weighting values depending on the objectives and individual inclusion of individual criteria in the model describing the investigated problem. This project involves the application of selected MCDA methods to the problem of assessing the share of renewable energy sources in the energy management of 30 European countries. Preliminary research work will be carried out to identify the limitations of known MCDA methods in the context of the analyzed problem. The main objectives of the research include the development of a new multi-criteria method that builds a ranking of alternatives based on reference solutions, which, while retaining the advantages of known MCDA algorithms such as simplicity, clarity and speed, will enable the elimination of their limitations, which include linear compensation of criteria. Another objective of the research work is to develop methods for prioritizing determinants of sustainable energy development based on available reference rankings. The project also includes work on extensions of multi-criteria methods, creating rankings based on reference solutions determined based on individual strategies for the assessed countries.

In the preliminary research, methods such as TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution), VIKOR (Vise Kriterijumska Optimizacija I Kompromisno Resenje) and COMET (the Characteristic Objects METhod) will be used. After preliminary research, the set of methods will be expanded. The project aims to develop such an approach based on multi-criteria methods, which will make it possible to obtain the most objective assessments of the sustainability of the use of renewable energy sources by European countries. An important role in the presented study is played by the comparative analysis of the obtained results with reference methods, whose aim is to confirm the reliability of the results and the adequacy of the selected methods for the investigated problem. If the results of the selected method will give results that differ from the others, it will be possible to consider replacing it with another method more suitable for solving this problem.

It was planned to create two models with different levels of detail of criteria to illustrate the problem under study. These are the simplified and extended models, incorporating criteria made available by the European Statistical Office (EUROSTAT). The next stage planned for the project is to perform a sensitivity analysis to determine the susceptibility and robustness of the rankings to a change in significance, i.e. the weights of the criteria considered. It is also planned to determine the degree of similarity of the obtained rankings using the four ranking similarity coefficients. The preliminary research results have shown that the selected MCDA methods effectively support the process of analysis, evaluation, and ranking in RES issues.

The expected result of the work planned in this project will be selecting a set of multi-criteria decision analysis methods most suitable for solving the problem of sustainability assessment of renewable energy sources by European countries. Furthermore, the set of selected methods will be used to implement their extensions, taking into account the specificity of the problem of sustainability assessment in the energy sector. Such a model taking into account MCDA methods and selected criteria with appropriate weights will be able to be used for objective evaluation of the implementation of policies and strategies assuming increasing the share of renewable energy sources in the economy, for evaluation of the progress of individual countries in the implementation of energy policy goals and for identification of strengths and weaknesses of individual countries in pursuit of increasing the share of renewable energy sources in the energy economy.