

MULTI-CRITERIA ANALYSIS AS A SUPPORT FOR NATIONAL ENERGY POLICY REGARDING THE USE OF BIOMASS Case Study of Serbia

by

**Damir D. DJAKOVIĆ^{a*}, Branka D. GVOZDENAC-UROŠEVIĆ^a,
and Goran M. VASIĆ^b**

^a Faculty of Technical Sciences, University of Novi Sad, Novi Sad, Serbia

^b Guarantee Fund of the Autonomous Province of Vojvodina, Novi Sad, Serbia

Original scientific paper

DOI: 10.2298/TSCI150602190D

Decision makers make decisions taking into account many different factors. That is why different experiences, living standard and other „non-technical“ conditions may lead to different decisions in different countries, or even regions of the same country. This paper deals with information gathered through a survey made among experts already dealing with different aspects of biomass use. Recognized factors influencing the wider use of biomass are arranged in a strengths, weaknesses, opportunities, and threats matrix. This matrix is used as a base to gather the opinions of the experts interviewed. Conclusions were made taking into account the most influential factors on the decision making process in biomass use according to the results. The questions of the survey were chosen according to existing results, as well as based on the authors' own experience and estimated relevance to the situation of the country analyzed (Republic of Serbia). The survey analysis covered the responses of 62 national experts in this field. Based on the gathered data, a proper multi-criteria analysis was done using the analytic hierarchy process and analytic network process methods. Afterwards, recommendations and comments to the decision makers and developers of national energy strategies are presented.

Key words: biomass use, multi-criteria analysis, strengths, weaknesses, opportunities, and threats, analytic hierarchy process, analytic network process, energy policy

Introduction

In order to form an applicable and sustainable energy policy, all influencing factors need to be identified, analyzed and processed. Based on that analysis, a list of achievable goals needs to be defined, together with a roadmap for their achievement. The roadmap must be unambiguous and carefully developed. For the successful implementation of the developed energy policy and strategy, it is necessary that the document reflects the current status in the field, as well as the opinion of experts and actors who will pursue the objectives proclaimed in the strategy. There are numerous papers presenting the advantages of biomass use. The potential and use of biomass in the Republic of Serbia are not analyzed in this paper. However readers interested in this topic are directed to previously published papers on this subject [1-4].

* Corresponding author; e-mail: djakovic@uns.ac.rs

The authors of this paper have identified and selected some of the most important regional factors which can influence wider biomass use in the region. For the identification and analyses of these factors, a strengths, weaknesses, opportunities, threats (SWOT) matrix was used. This approach is widely used in many other situations, sectors, and purposes and has proven to give satisfactory results. The SWOT matrix developed was used to carry out an investigation of the opinions of national experts on this topic. The results were processed using the multi-criteria analysis tools presented in the following text. The results, based on multi-criteria decision analysis (MCDA), are used to make recommendations to energy policy creators about the thinking of experts in the biomass energy field; what they find to be important to be resolved and clarified to achieve wider biomass utilization in the region.

The MCDA tools – state-of-the-art

In order to make a decision, the decision maker should have sufficient quality information, analyzed according to set criteria. A criterion is a means by which a particular action can be chosen to be more desirable than another. In the field of multi-criteria decision making problems, a decision maker uses several criteria to make such judgments.

Experts can provide help to policy makers in making appropriate decisions with their own specialized in-depth knowledge (or perception of things as they are) [5, 6]. Since it is almost impossible to analyze the perception of the many factors influencing the process of decision making without some kind of mathematical approach, it has become common to assign numerical values to the linguistic descriptions.

Multi-criteria decision analysis is a discipline that encompasses mathematics, management, informatics, psychology, social science, and economics. A large number of methods have been developed to solve multi-criteria problems. This development is ongoing [7] and the number of academic MCDA-related publications is steadily increasing.

After psychological experiments done by Miller [8] during the fifties of the twentieth century, where it was proved that human mind cannot process more than seven plus/minus two pieces of information at a time, Saaty and Vargas [9] derived the pairwise comparison scale from 1 to 9 which became an acceptable standard for this kind of analysis. We have used this approach and scale to nine in gathering data from interviewees and forming weight coefficients.

This pairwise comparison became the foundation used in several multi-criteria decision tools, *e. g.* analytic hierarchy process (AHP), analytic network process (ANP), *etc.* [7].

There are several multi-criteria decision analysis tools (AHP, ANP, and combinations SWOT-AHP, SWOT-ANP, *etc.*). Some are listed, divided by type of problem solving [7]:

- choice problems – AHP, ANP, MAUT/UTA, MACBETH, PROMETHEE, ELECTRE I, TOPSIS, Goal Programming, DEA,
- ranking problems – AHP, ANP, MAUT/UTA, MACBETH, PROMETHEE, ELECTRE III, TOPSIS, DEA,
- sorting problems – AHPSort, UTADIS, FlowSort, ELECTRE-III, and
- description problems – Gaia, FS-Gaia.

Considering the number of MCDA methods available, the decision maker is faced with the arduous task of selecting an appropriate decision making support tool, and often the choice can be difficult to justify. None of the methods is perfect. They also cannot be universally applied to all problems. Each method has its own limitations, particularities, hypotheses, premises, and perspectives [7]. This paper describes briefly only the tools which are used in combination with SWOT. These are AHP and ANP analysis. The SWOT analysis itself originated from the

works of business policy academics at Harvard Business School and other American business schools from the 1960s [10]. The methodology presented in this paper, SWOT-ANP, is not presented in this paper for biomass related analyses for the first time. To the knowledge of the authors of this paper, there was one previous paper applying this methodology [11]. The main contribution of the work is the use of both SWOT-AHP and SWOT-ANP analyses and to recommend strategies according to the results obtained at the state level to support biomass use.

Methodology used

The first developed SWOT-AHP was described in Kurttila *et al.* [12]. Despite its advantages compared to the simple use of SWOT strategic tools, AHP also has limitations. It is assumed that the factors analyzed are mutually independent, whereas ANP analysis takes into account their mutual dependence, as well.

The AHP was developed by Saaty [13, 14] and this method has proved to be particularly useful when the decision maker is unable to construct a utility function. A basic premise of AHP is that *knowledge* actually represents our instinctive sense of the way the things really are [9].

A combination of SWOT and AHP can be used as a tool in the decision making processes.

The SWOT-AHP/ANP analyses were made of the results of a survey conducted among 62 expert participants at a specialized biomass session during the 8th Clean Energy Technologies Forum 2014, held in Novi Sad, Serbia, and it was based on a previously delivered paper [15, 16]. These participants were people from the academic, industrial, municipal, and political arenas dealing with and interested in the application of different biomass fields. In the first part the participants were asked to estimate the influence of three criteria of SWOT analysis on the enhancement of the remaining one (*i. e.* how much more one element dominates another from absolute domination represented by 9, decreasing to 1 representing equal importance, and then increasing to absolute domination of the second factor represented by 9). In the second part of the survey the participants were asked to estimate the relative importance of the criteria inside the same group (SWOT) assigning to them a numerical value in the manner previously described. The criteria in these groups were chosen by the authors of the paper based on the authors previous experience and knowledge, and they were checked through the presentations delivered earlier [15], and during the work on projects mentioned in the section *Acknowledgments*. It had to be done in this manner, because of the technical impossibility of doing this part of the research with the same sample group of experts, *i. e.* to first allow them to list all of the factors in their opinion for each of four SWOT groups, and to immediately decide which are the most influential and then to offer the 2nd part of the survey.

The survey was constructed following the basic idea developed by Saaty and Vargas [9]. The fundamental scale according to [9] and other authors using Saaty's ideas, *e. g.* [11], is described: 1 = equal importance, 3 = weak importance of one over another, 5 = strong (or essential) importance, 7 = demonstrated importance, and 9 = Absolute (extreme) importance.

Explanations are given for the following intensities of importance: 1, 3, 5, 7, and 9 and ranges from *Two activities contribute equally to the objective* (1) to *The evidence favoring one activity over another is of the highest possible order of affirmation* (9). Saaty also assumes that if activity "*i*" has a non-zero number assigned to it when compared to activity "*j*", then "*j*" has a reciprocal value when compared to "*i*". A detailed overview of the survey is given in [16].

In order to use AHP the user needs to complete four steps in order to rank the alternatives. The problem has to be structured first. Then, the scores (priorities) are calculated based on the pairwise comparisons provided by the users. After that a consistency check and a sensitivity analysis can be carried out. Both these steps are optional, but useful as a check of the robustness of the results.

The comparison matrices are made using the pairwise comparisons between the criteria. These matrices are reciprocal, because the lower triangle is reversible according to the upper triangle, and comparisons on the main diagonal are 1, because at these locations the criterion is compared with itself.

The pairwise comparisons among the criteria in each of the groups of a SWOT are usually presented in a matrix with their weights w_1, w_2, \dots, w_n . If this matrix is multiplied by the column vector (w_1, w_2, \dots, w_n) the following vector is obtained nw : $An = nw$, where n is the eigenvalue of A (a root of the characteristic equation of A) if this equation has a non-zero solution.

After the matrix A is made (for each of the analyzed cases, *i. e.* four matrices are made for general criteria in the SWOT matrix, and four matrices are made for criteria which constitute each of the general criteria SWOT), the normalized matrix is made, and finally, the priorities of each of the analyzed matrix component (each matrix is 3×3) are calculated. The priorities represent the relative impacts of the criteria.

It is also necessary to check the consistency ratio (CR). In this paper it was done by CR calculation. The CR tells us how consistent the examined experts are in their answers. The CR is calculated by dividing the consistency index (CI) and random consistency index (RI). The CI is calculated as a ratio of $(\lambda_{\max} - 1)$ and $(n - 1)$, where λ_{\max} is the maximum eigenvalue of the matrix and n is the number of criteria (3 in this case, since the matrix is 3×3). An ideal case, when the comparison matrix is fully consistent, will be represented by $\lambda = n$. The RI represents the consistency of a randomly generated pairwise comparison matrix. Since the number of items compared in the matrix was 3, for RI a value of 0.58 was used.

A higher number means less consistency, whereas a lower number means higher consistency. In general, if the CR is 0.10 or less, the decision maker's answers are relatively consistent. For a CR that is greater than 0.10, but less than 0.2 the decision maker can consider re-evaluating the responses during the pairwise comparisons that were used to obtain the original matrix of pairwise comparisons, while for a consistency ratio bigger than 0.2, a re-evaluation should be considered.

Pairwise comparisons among the influences of two chosen groups of SWOT analysis to each of the group elements (*e. g.* influence of weaknesses and opportunities group to the enhancement of the strengths, *etc.*) were made according to the results of the survey conducted. After that an analysis was made according to the pairwise comparisons between the factors of each of the groups analyzed (comparisons between the influences of two factors in the group of SWOT). The factors inside these four groups of SWOT matrix were chosen by the authors of this paper as relevant for the current situation in Serbia. The SWOT matrix is shown in tab. 1.

As well as the presented factors influencing decisions on biomass use, this renewable energy sources has a wider and stronger relation to and benefits for economic and social development. These aspects are exceptionally important and for this reason the increased use of this renewable energy resource at the national level is in the interests of Government and national energy policy makers. The social aspect of biomass use for energy purposes is reflected in the fact that at the national level, its use leads to reduced dependence on imports

Table 1. Chosen factors of four SWOT matrix groups

STRENGTHS	WEAKNESSES
S1 Reduction of national energy dependence and improvement of security of energy supply S2 Reduction of CO ₂ emission at a national level S3 Opening of new working places and development of rural areas	W1 Non-existence of regulated biomass market W2 High investment costs W3 Non-availability of feed for bigger power plants
OPPORTUNITIES	THREATS
O1 Use of land which could not be used for food production purposes for energy crops O2 Development of more favorable credit lines for renewable energy sources O3 Development of new technologies and infrastructure	T1 Unclear, unstable, and unpredictable energy policy T2 Competition with other energy sources T3 Lack of private sector investments

and to the employment of the local population in newly created jobs. The national labor force is engaged in the construction and installation, designing, servicing, sometimes in the production of the plant and related equipment, *etc.* Other motives for using biomass for power generation are: the prevention of soil erosion by means of energy crops, the reduction of fire disasters due to woody wastes in forests and organic wastes in agricultural fields, and the development of a new industrial sector for biomass power technology and services [17].

The results of SWOT-AHP analysis

The results of the calculations were obtained by spreadsheet application. The results of calculated priorities and corresponding CR are shown in tab. 2, for each of the groups analyzed. The highest priority values are in bold.

The internal analysis of four groups

The overall AHP analysis done in this paper was structured in the way presented in fig. 1.

The results obtained from the internal analysis of the criteria inside these four groups (SWOT) are shown in tab. 3. The highest priority values are in bold.

In this analysis, most of the CR were lower and even much lower (as for weaknesses and analysis of other elements of SWOT matrix influence on the opportunities) than the

Table 2. Calculated priorities of SWOT groups influence and corresponding CR

(a) What is more important for the enhancement of the strengths? (CR = 0.1231)	
Weaknesses reduction	0.352
Opportunities enhancement	0.431
Threats reduction	0.217
(b) What is more important for reducing the weaknesses? (CR = 0.0439)	
Strengths enhancement	0.329
Opportunities enhancement	0.428
Threats reduction	0.243
(c) What is more important for enhancement of the opportunities? (CR = 0.0042)	
Strengths enhancement	0.505
Weaknesses reduction	0.292
Threats reduction	0.203
(d) What is more important for reduction of the threats? (CR = 0.0342)	
Strengths enhancement	0.308
Weaknesses reduction	0.306
Opportunities enhancement	0.386

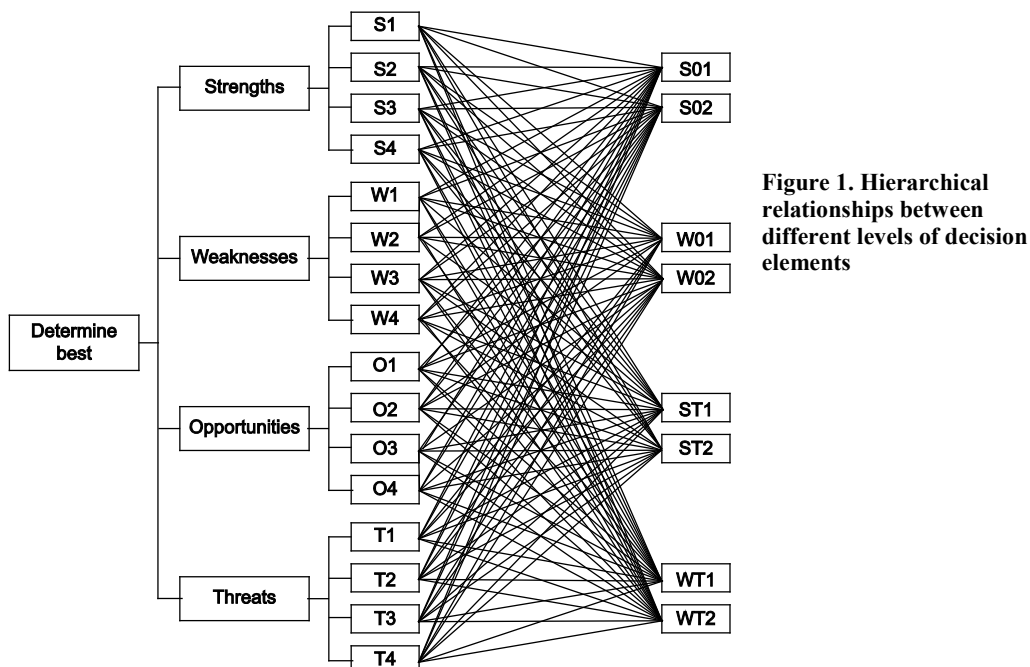


Figure 1. Hierarchical relationships between different levels of decision elements

Table 3. Internal criteria and their CR

Strengths (CR = 0.1005)		
S1	Reduction of national energy dependence and improvement of security of energy supply	0.601
S2	Reduction of CO ₂ emission at national level	0.066
S3	Opening of new working places and development of rural areas	0.333
Weaknesses (CR = 0.0002)		
W1	Non-existence of regulated biomass market	0.359
W2	High investment costs	0.289
W3	Non-availability of feed for the big power plants	0.352
Opportunities (CR = 0.0107)		
O1	Use of land which could not be used for food production purposes for energy crops	0.230
O2	Development of more favorable credit lines for renewable energy sources	0.315
O3	Development of new technologies and infrastructure	0.456
Threats (CR = 0.0924)		
T1	Unclear, unstable, and unpredictable energy policy	0.511
T2	Competition with other energy sources	0.199
T3	Lack of private sector investments	0.291

suggested value(s), except in the case of analysis of other elements of the SWOT matrix influence on the strengths. This leads to the conclusion that the answers provided by most of the experts were carefully considered, since in most categories they are very consistent. The overall priorities of AHP analysis are shown in fig. 2.

The ANP analysis

The ANP analysis is a generalization of AHP where the dependencies (also named feedbacks) are included. In ANP a hierarchical approach is not necessary. The supermatrix in its standard form is shown, where w_1 represents the weight of criteria (SWOT) elements, W_2 represents the effect of interdependence at the criteria level, while W_3 represents the local priorities of the sub-factors of criteria converted into global priorities by multiplication with $(W_2 w_1)$ which is usually named interdependent criteria weight. The ultimate priorities of the decision alternatives are determined by multiplying the priorities of the alternatives calculated with respect to sub-factors, W_4 , and global priorities of sub-factors.

$$W = \begin{bmatrix} 0 & 0 & 0 & 0 \\ w_1 & W_2 & 0 & 0 \\ 0 & W_3 & 0 & 0 \\ 0 & 0 & W_4 & 1 \end{bmatrix}$$

Overall priority relations for ANP analysis are shown in fig. 3.

The relative relations among the factors remain unchanged, except the higher values for the opportunities than for the threats in AHP analysis, and *vice versa* (concerning the highest value) in ANP analysis, so the tendencies obtained by both approaches are comparable.

Results and discussion

It can be concluded that the answers given by the experts taking part in the survey were very consistent according to the calculated CR. Consistencies were below 0.10 for all of the categories except two, where acceptable consistencies of 0.1005 and 0.1231 were calculated. That leads us to the conclusion that the opinions used in these surveys could be used with great reliability for the creation of future energy policies related to biomass and in the removal of obstacles to its more intensive use.

It is interesting to notice that among the biomass experts interviewed for each of the categories analyzed, *opportunities enhancement* as a choice for improvement prevailed. The most important for the opportunities was *strengths enhancement*. It indicates that biomass experts are more likely to favor these two *positive* categories of the SWOT matrix over the *negative* ones.

Concerning the possibilities of threats reduction, the experts' answers were approximately equally distributed among the categories of strengths, weaknesses, and opportunities. According to the results obtained, opportunities had slightly more influence (0.386).

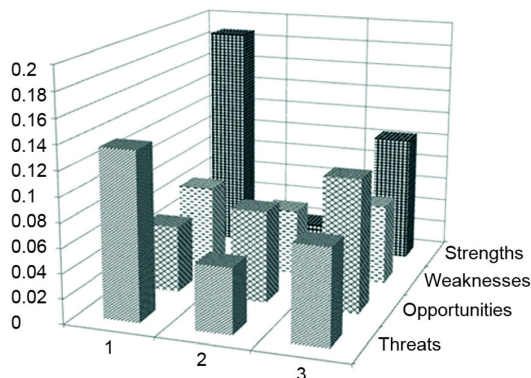


Figure 2. Overall priorities for AHP analysis

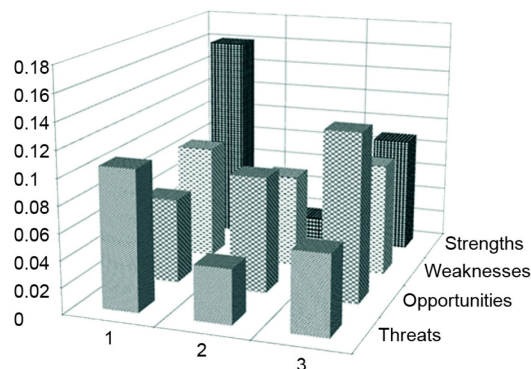


Figure 3. Overall priorities of the factors for ANP analysis

In internal analysis of the categories of SWOT, according to the answers for each of the SWOT categories, the experts considered the reduction of national energy dependence and reliability and security of energy supply as the biggest strength, while CO₂ emissions reduction at a national level is of almost negligible importance.

Concerning the weaknesses, the experts' opinion is more equally distributed, with emphasis on the non-existence of a regulated biomass market (0.359). Concerning the opportunities, the attitude that the most important is development of new technologies and infrastructure prevails (0.456). The experts see the unclear, unstable, and unpredictable energy policy as the biggest threat.

The current situation in Serbia regarding biomass use is characterized by proven potentials in several types of biomass (agricultural, wood), the non-existence of a regulated biomass market, unclear and complex regulations and procedures, and an underdeveloped and unclear legal and institutional framework to ensure a continuous and stable biomass supply.

The recommendations and support for the development of renewable energy strategies regarding the use of biomass are presented in tab. 4 (SO – strengths/opportunities, WO – weaknesses/opportunities, ST – strengths/threats, and WT – weaknesses/threats).

Table 4. The SWOT matrix with recommendations for support for the development of renewable energy strategies regarding biomass

	<i>Strengths</i>	<i>Weaknesses</i>
<i>Opportunities</i>	<u>SO</u>	<u>WO</u>
	SO1 Reinforcement of incentives for biomass use SO2 Stronger national commitments to achieving a secure energy supply	WO1 Urgent development of regulated biomass market WO2 Ensuring a more reliable and secure legal, financial and social environment for investors
<i>Threats</i>	<u>ST</u>	<u>WT</u>
	ST1 Clarification and simplification of regulations, procedures, and permit processes ST2 Legislation harmonization at vertical and horizontal levels of authority	WT1 Increase investors' confidence in the state authorities WT2 Development of strong legal and institutional framework to ensure a continuous and stable biomass supply

Conclusions

Public and experts opinion as well as the results obtained are crucial input information in the continuous process of improvement of the current situation in order to achieve the proclaimed goal. The results in this paper represent the opinion of experts on current regulations, use of biomass, and overall benefits and conditions for achieving wider use of biomass. Taking into account that for strengths the most influential are opportunities enhancement (for Serbian conditions), while for opportunities the most influential are strengths enhancement, it can be concluded that among the four main strategy groups derived, the SO strategy pair is the most important. This is a starting point for future steps for the main actors in developing, harmonization, monitoring and improvement of the national energy strategy, and policy. The results are presented in the form of recommendations at the national level for the adaptation of the existing energy strategy and policy to increase the use of biomass and to ensure a secure and stable environment for potential investors. The tendencies obtained by both SWOT-AHP and SWOT-ANP are comparable, and both approaches give results relevant to the decision making process.

Comparing the results obtained with SWOT-ANP analysis with the results presented in other papers, e. g. in [11, 18-24], it is noted that the more developed the analyzed field in a particular region/country is, the more experts perceive negative factors (weaknesses and threats) to be of greater importance than positive (strengths and opportunities) in achieving goals, and *vice versa*.

In this paper the opinions of the experts are quantified by the authors using multi-criteria analysis tools of decision making.

Decision makers who will form future energy policy in Serbia based on the very clearly formulated attitudes of these experts can count on their support in the moment of decision, as well as during the time of its implementation.

Acknowledgment

The authors would like to thank to Ministry of Education, Science and Technological Development of Republic of Serbia and to Provincial Secretariat for Science and Technological Development for funding two projects within which part of research leading to this paper was done:

- Development and construction of demo plant for combined heat and power generation with biomass gasification, TR 33049, 2011-2015, financed by Ministry of Education, Science and Technological Development of Republic of Serbia.
- Planning of power systems in cities of Vojvodina province using modern energy technologies, 114-451-2235/2011, 2011-2015, financed by Secretariat for Scientific and Technological Development of AP Vojvodina.

References

- [1] Brkić, M. J., et al., Assessment of Species and Quantity of Biomass in Serbia and Guidelines of Usage, *Thermal Science*, 16 (2012), Suppl. 1, pp. S79-S86
- [2] Glavonjić, B. D., Oblak, L. Z., Consumption of Woody Biomass in Industry, Commercial, and Public Facilities in Serbia Present State and Possible Contribution to the Share of Renewable Sources in Final Energy Consumption, *Thermal Science*, 16 (2012), 1, pp. 7-19
- [3] Radovanović, P. M., et al., Opportunities of Solid Renewable Fuels for (Co-)Combustion with Coal in Power Plants in Serbia, *Thermal Science*, 18 (2014), 2, pp. 631-644
- [4] Vasiljević, A. Lj., Potentials for Forest Woody Biomass Production in Serbia, *Thermal Science*, 19 (2015), 2, pp. 397-410
- [5] Gvozdenac, D., et al., Serbian Energy Efficiency Problems, *Thermal Science*, 18 (2014), 3, pp. 683-694
- [6] Pusnik, M., et al., Role of the National Energy System Modeling in the Process of the Policy Development, *Thermal Science*, 16 (2012), 3, pp. 703-715
- [7] Ishizaka, A., Nemery, P., *Multi-Criteria Decision Analysis, Methods and Software*, John Wiley & Sons, Ltd. Chichester, UK, 2003
- [8] Miller, G. A., The Magical Number Seven Plus or Minus Two: Some Limits on our Capacity for Processing Information, *Psychological Review*, 63 (1956), 2, pp. 81-97
- [9] Saaty T. L., Vargas L. G., *The Logic of Priorities*, Springer-Science and Business Media, New York, USA, 1982
- [10] Hill, T., Westbrook, R., SWOT Analysis: It's Time for a Product Recall, *Long Range Planning*, 30 (1997), 1, pp. 46-52
- [11] Catron, et al., Bioenergy Development in Kentucky: A SWOT-ANP analysis, *Forest Policy and Economics*, 28 (2013), Mar., pp. 38-43
- [12] Kurttila, M., et al., Utilizing the Analytic Hierarchy Process (AHP) in SWOT Analysis – a Hybrid Method and its Application to a Forest-Certification Case, *Forest Policy and Economics*, 1 (2000), 1, pp. 41-52
- [13] Saaty, T. L., A Scaling Method for Priorities in Hierarchical Structures, *J. Math. Psychol.*, 15 (1977), 3, pp. 234-281

- [14] Saaty, T. L., *The Analytic Hierarchy Process: Planning, Priority Setting, Resource Allocation*, McGraw-Hill, Houston, Tex., USA, 1980
- [15] Đaković, D., et al., Logistics of Supply of Energy Plant by Biomass (in Serbian), *Proceedings, 27th International Congress on Process Engineering Processing*, Belgrade, 2014
- [16] Đaković, D., Gvozdenac-Urošević, B., SWOT Analysis of Biomass Plant Supply Logistics, *Proceedings* (ed. D. Gvozdenac), VIII Forum on Clean Energy Technologies, Novi Sad, Serbia, 2014
- [17] Urošević, D., Gvozdenac-Urošević, B., Comprehensive Analysis of a Straw-Fired Power Plant in the Province of Vojvodina, *Thermal Science*, 16 (2012), Suppl. 1, pp. S97-S106
- [18] Hussain, D., et al., A Study of Textile & Clothing Supply Chain in Pakistan, *Proceedings, 2nd International Conference on Engineering Optimization*, Lisbon, 2010
- [19] Yavuz, F., Baycan, T., Use of SWOT and Analytic Hierarchy Process Integration as a Participatory Decision Making Tool in Watershed Management, *Procedia Technology*, 8 (2013), pp. 134-143
- [20] Hongshen, Z., Ming, C., Research on the Recycling Industry Development Model for Typical Exterior Plastic Components of End-of-Life Passenger Vehicle Based on the SWOT Method, *Waste Management*, 33 (2013), 11, pp. 2341-2353
- [21] Kajanus, M., et al., Making Use of MCDS Methods in SWOT Analysis – Lessons learnt in Strategic Natural Resources Management, *Forest Policy and Economics*, 20 (2012), July, pp. 1-9
- [22] Mehmood, F., et al., Analytical Investigation of Mobile NFC Adaption with SWOT-AHP Approach: A Case of Italian Telecom, *Procedia Technology*, 12 (2014), pp. 535-541
- [23] Sevkli, M., et al., Development of a Fuzzy ANP Based SWOT Analysis for the Airline Industry in Turkey, *Expert Systems with Applications*, 39 (2012), 1, pp. 14-24
- [24] Shariatmadari, M., et al., Using SWOT Analysis and SEM to Prioritize Strategies in Foreign Exchange Market in Iran, *Procedia – Social and Behavioral Sciences*, 99 (2013), Nov., pp. 886-892