Efficient energy use and renewable sources of energy in Slovenia: a survey of public perception

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Abstract: This paper presents unique survey results with opinions on the competitive supply and efficient energy use, sources of energy and renewable sources of energy. The multivariate factor analysis with three common factors confirms the significance of the price competitive supply of energy, energy costs for the economy, and the sustainable energy supply development and ecological perception in the energy use. Among renewable sources of energy, significance is given to the solar, hydro, biogas, and biomass energy, where the energy use and the renewable energy production in agriculture can play a greater role. Education and promotion activities are expressed as important for strengthening the knowledge, awareness, and social responsibility of the sustainable energy development and the use of renewable sources of energy.

Key words: energy efficiency, renewable sources of energy, operation management, sustainability, social responsibility

Among the strategic objectives in the European Union (EU) member states in the field of the energy sector, there are the objectives to improve the efficiency in energy supply and use and to increase the use of renewable sources of energy (e.g. Jeníček and Krepl 2009). In this present paper, we want to investigate the factors affecting societal preferences of the sample cluster of the natural sciences for the sustainable energy production and use. We are showing what the respondents' opinions of this cluster of energy users are and how their preferences link to each other on the competitive energy supply, on a more efficient energy use, and on the potentials to increase the production and use of renewable sources of energy in general and in agriculture. The term competitive energy supply relates to the electricity pricing with the competitive supply conditions. The efficient energy use relates to a more rational, energy saving use, which can be achieved with a more efficient direct use of energy, such as the energy saving electric bulbs and household appliances with a lower use of energy, and more efficient indirect measures for the use of energy, e.g. with a better energy insulation construction of buildings and similar buildings for heating or air-conditioning. We expect that an important role in the dissemination of knowledge on a more the efficient supply and energy use and on the greater use of renewable sources of energy is played by the education and promotion activities giving a better understanding of sustainable development in the context of climatic changes and energy needs.

The business interests of suppliers of energy can be in contradiction with an efficient use of energy and the development of alternative, renewable sources of energy, which at the same time have effects on the environment and on competitiveness (Nordhaus 1994; Fussler 2002; Stern 2007; Wagner et al. 2007; Bojnec and Papler 2011). The competitive supply of energy is also related to the developments on the international energy markets such as, for example, on the oil market with its price oscillations. The literature on ecological management and sustainable development (Graedel 1996; Roome 2001) and the entrepreneurial strategies of enterprises (Sinding 2000) includes sustainable components in the economic growth (Priemus 1994). This issue of sustainability in the economic growth is broader than considering only the positive effects of technological changes and the development of sustainable technologies (Weaver et al. 2000) and their positive externalities in the economic growth (Samuelson and Nordhaus 1995). For an efficient use (Segger 1999) and management of primary products (Barbiroli 1984), of a particular importance are the strategies and management that are associated with the industry and manufacturing activities (Frosch and Gallopoulos 1989). They might have negative implications for the environment and sustainable development. Among them, there is also the energy supply and the energy operation management with the competitive supply, the efficient use of energy, and the development and use of renewable sources of energy, particularly for the energy use and renewable energy production in agriculture.

In this paper, we present the findings of our research on the opinions and societal preferences with the perceptions of the sample of the respondents in the natural sciences to the written questionnaire on the sustainable energy production and use. We concen-

trate on societal priorities in association with the natural sciences respondents' characteristics which affect these priorities.

The paper contributes to the literature in three significant directions. First, by sharing the in-depth survey results of the opinions on the societal preferences and perceptions, the awareness and knowledge on the competitive energy supply, efficient energy use, sources of energy and the promotion of renewable sources of energy. Public opinions on the analyzed subjects are investigated in the context of climatic changes, energy production and energy needs. Second, the focus is on the analysis and presentation of the societal preferences and perceptions that are obtained by the case study for the natural science group school in Slovenia. The analyzed questions are important for synergies with the management of technology and operation, the stimulation of innovation and the transfer of technology for sustainable production and energy use, and the renewable energy production in agriculture. Finally, the competitive energy supply, the efficient energy use, and a greater relative role of renewable sources of energy require a proper knowledge, managerial awareness, and proper institutional policy frameworks and measures, which are important challenges for Slovenia as well as for other developed countries and countries in transition. We aim to underline the importance of a more competitive energy supply and an efficient energy use with the implications for the rationalization of energy supply management on one hand, and, on the other, the identification of different sources of energy with the significance of the production of renewable sources of energy from different sources that might be supported by government measures, the education and promotion activities in raising awareness and societal priorities for more underlined sustainable development with environmental protection. We also evaluate the respondents' opinions in the light of the objective to achieve a 20 per cent share of production of electric energy from the renewable sources of energy by 2020. This is the objective of the EU, while Slovenia has voluntarily adopted the objective to achieve a 25 percent share of the production of electric energy from the renewable sources of energy by 2020.

METHODOLOGY AND DATA

As the methods of the analysis, we have used the correlation analysis and the multivariate factor analysis of the unique survey data. One of the basic elements used in the correlation analysis is the correlation coefficient, which is defined on the interval value between –1 and 1. The sign tells us the direction of linear dependence between the pair of variables. The absolute value of the correlation coefficient shows the degree of linear dependence between the analysed pair of variables. The correlation does not mean that the pair of variables is dependent as a cause and implication. Very often, the pair of variables can be dependent on a third factor, which might not be known. Due to this, we will also use the multivariate factor analysis, which will show the most important common factors and the weights of variables, which are important for the explanation of the analysed phenomena (e.g. Kachigan 1991). The objective of the multivariate factor analysis is to find a smaller number of underlying factors or latent constructs from a greater number of variables, that cannot be measured directly, but which affect the variables that are measured. In order to test the sensitivity of the results on different methods of factor analysis and to find an appropriate interpretation of the results, we employ different multivariate factor analysis techniques of extraction (e.g. Mulaik 2010). The data appropriateness for using the multivariate factor analysis approach and the number of common factors are tested by using the standard statistical tests and the scree plot. The Cronbach's alpha (ά) of the internal consistency indices of reliability is used to test the reliability of the questionnaire and to assess the reliability of an underlying construct. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and the Barlett's test of sphericity are used as the measures of the appropriateness of factor analysis. The common factors are interpreted based on the absolute size of the weights of variables in the structure loadings.

The written questionnaire used in the surveys was agreed previously with the Slovenian Ministry of the Environment and Spatial Planning. The questionnaire was divided into three parts: first, data on the respondents (gender, age groups, and education groups). Second, the opinions on the competitive supply and efficient energy use, using the Likert scale statements from 1 – not important to 5 – very important. Third, the opinions on sources of energy and renewable sources of energy, support measures and the awareness using the Likert scale statements from 1 – not important to 5 – very important. The description of the questions in the questionnaire is presented in more detail when we report the summary statistics on each question in the questionnaire.

The surveys were conducted between June and July 2008 on the basis of the prepared written questionnaire. In the surveys, there were included staff and students of the final year of the Secondary Biotechnical School, and the first year students of the Higher

Table 1. Summary statistics of the respondents by gender, age and education

		N = 83, structure in %
Gender	male	32.5
	female	67.5
Age (years)	up to 24	63.9
	25 to 29	2.4
	30 to 34	10.8
	35 to 39	2.4
	40 to 44	7.2
	45 to 49	8.4
	50 to 55	3.6
	over 55	1.2
	average	35.4
Education	secondary	56.6
	higher	16.9
	college	3.6
	Bologna I	0.0
	university	21.7
	specialist	0.0
	Bologna II	0.0
	scientific master	1.2
	doctorate	0.0
Average completed years of schooling including primary education		13.4

Source: Survey results

School of the Biotechnical Centre Naklo in Slovenia. We distributed 130 questionnaires, and 83 (64%) were returned in the completed form. By gender, the majority of those included in our sample are women (Table 1). The average age (35.4 years) and the sample composition by the age structure indicate that a large proportion in the sample includes employees (teachers, technical and other staff) and part-time students. The average duration of the completed education years, including primary education, is 13.4 years. By the education composition, the prevailing level is that of the completed secondary school.

EMPIRICAL RESULTS

Competitive supply and efficient energy use

The written questionnaire on the competitive supply in the electro-energy system and on the efficient use of energy was covered by 13 questions in the Likert-scale form with scores from 1 (not important) up to 5 (very important). The Cronbach's $\acute{\alpha}$ = 0.815 confirms the reliability of the questionnaire. Table 2 presents mean values of the answers by the 83 respondents to the questionnaire statements on the competitive supply and efficient energy use.

According to the respondents' opinions, the following variables have the highest mean values: that the economy significantly contributes to the increases of the CO_2 gas emissions in the atmosphere (CO_2 gas emissions); the use of energy in the economy is relatively high (energy in the economy); the price of electric energy has become an important element in the costs of enterprises (costs); the consideration of the importance of the efficient, more saving use of energy (efficient energy use); the households can save more electric energy (electricity in households); the use of alternative sources of energy reduces the environment pollution (alternative sources of energy); the progress in the competitive supply and efficient energy use is very much dependent on the adjustments to the new competitive market conditions and the government support (progress of competitive supply); and the consciousness of ecological ways of operation and substitutes for the ecologically unfriendly sources of energy (ecological consciousness). The modest mean values are found for the following variables: that the knowledge for the efficient energy use with the ecological awareness in the field of energy is important (knowledge); the research and development (R&D) will give new advanced solutions/technologies, which will contribute to energy supply in an environmentally friendly way; and the competition between different suppliers of electric energy is visible on the market by the opportunities for the competitive choice among different suppliers of electric energy (competition). The lowest mean values are found for two variables: the prices of energy are reasonable with respect to the high consumption (prices of energy) and the prices of electric energy for households are too low (prices of electricity in households).

The correlation analysis shows the direction and intensity of association between the analyzed pairs of variables. The Pearson's correlation coefficient is the highest between the pairs of variables for the energy in households and energy in the economy (0.59), the knowledge and costs (0.55), electricity in households and costs (0.55), and between the knowledge and R&D (0.54). These numbers suggest a modest degree of the associations between these pairs of variables. For the other analyzed pairs of variables, the Pearson's correlation coefficient is less than 0.5, implying that the partial correlations between them are at relatively lower degrees.

The Bartlett's test of sphericity shows the significance of the data (approx. Chi-square 310.63, Sig. 0.000).

The KMO measure of sampling adequacy is 0.78. Therefore, the Bartlett's test and the KMO measure imply suitability of the data for the multivariate factor analysis. The multivariate factor analysis model is estimated in two steps. In the first step, we estimate the shares of the explained variance of the analyzed variables with the common factors/communalities by the principal axis factoring method and by the maximum likelihood method. In the second step, we estimate the factor weights with rotation methods. Maximum likelihood with the oblique rotation method and with the Kaiser normalisation giving a structure matrix is chosen as an appropriate in order to get the best interpretation of results (Table 3). The scree plot on the number of common factors confirms three common factors. The explained variance by using thirteen variables is 54.5%: the first one explains 33.1%, the second one an additional 12.1%, and the third one an additional 9.4%. These results imply that an important percentage of the total variance up to 100% has remained unexplained, meaning that there are still some additional common factors, but with a lower additional explanation percentage of the total variance than is captured by the first three identified common factors. The Cronbach's ά coefficient for the each summated scale is close to or above the 0.70 criterion (Nunnelly 1978).

The application of the maximum likelihood with the oblique rotation method with the Kaiser normalisation confirms the three common factors: the first one is the price competitive supply of energy with the highest weight in variable for competition with the opportunities for competitive choice between different suppliers (Table 3). The second common factor is the energy costs, which has the highest weights in variables for electric energy in households, costs, energy in the economy, knowledge and CO_2 gas emissions. The third common factor is the sustainable energy supply development and the ecological perception in energy use, which has the highest weights in variables R&D, alternative sources of energy, knowledge and ecological consciousness.

Sources of energy and renewable sources of energy, support measures and awareness

The written questionnaire on the sources of energy and renewable sources of energy, their development

Table 2. Mean values for the competitive supply and efficient energy use

	Questionnaire statement	Variable	Mean value	SD
1	Use of energy in the economy is relatively high	energy in the economy	4.28	0.86
2	Use of alternative sources of energy reduces environment pollution	alternative sources of energy	4.08	1.13
3	Research and development (R&D) will give new advanced solutions/ technologies, which will contribute to energy supply in an environmentally friendly way	R&D	3.87	1.26
4	Economy significantly contributes to the increases of the CO_2 gas emissions in the atmosphere	CO_2 gas emissions	4.30	0.80
5	Households can save more electric energy in households	electricity in households	4.17	1.00
6	Knowledge of the fficient energy use with ecological awareness in the field of energy is important	knowledge	3.88	1.33
7	Consideration of the importance of the efficient, more saving use of energy	efficient energy use	4.18	0.98
8	Consciousness of ecological ways of operation and substitutes for the ecologically unfriendly sources of energy	ecological consciousness	4.02	1.10
9	Progress in competitive supply and efficient energy use is very much dependent on adjustments to the new competitive market conditions and government support	progress of competitive supply	4.07	0.90
10	Price of electric energy has become an important element in the costs of enterprises	costs	4.19	0.82
11	Competition between different suppliers of electric energy is visible on the market by opportunities for the competitive choice among different suppliers of electrical energy	competition	3.47	1.30
12	Prices of energy are reasonable with respect to high consumption	prices of energy	3.22	1.05
13	Prices of electric energy for households are too low	prices of electricity in households	2.73	1.73

Source: Survey results

Table 3. Multivariate factor analysis for the competitive supply and efficient energy use

	Maximum likelihood method – oblique rotation method with the Kaiser normalisation		
	structure matrix		
	1	2	3
Progress of competitive supply	0.134	0.408	0.197
Costs	0.370	**0.744**	0.339
Energy in the economy	0.169	**0.663**	0.126
Electricity in household	0.271	**0.761**	0.334
Price of electricity in households	0.349	0.160	0.237
Price of energy	0.390	0.123	0.234
Competition with choice between suppliers	**0.977**	0.395	0.304
Efficient energy use	0.135	0.299	0.427
Ecological consciousness	0.377	0.178	**0.599**
CO_2 emissions	0.306	**0.548**	0.485
Alternative sources of energy	0.442	0.081	**0.622**
Knowledge	0.372	**0.611**	**0.607**
R&D	0.312	**0.458**	**0.670**

Cronbach ά factor 1 = 0.802, N = 5 (costs, energy in the economy, knowledge, CO_2 emissions, electricity in households), Cronbach ά factor 2 = 0.730, N = 5 (R&D, alternative sources of energy, ecological consciousness, knowledge, efficient energy use), Cronbach ά factor 3 = 0.686, N = 5 (competition with competitive choice between suppliers, price of energy, prices of electricity in households)

and promotion comprises 23 questions on the Likert scale, ranging from 1 (not important) up to 5 (very important). The Cronbach's ά = 0.915 confirms the reliability of the questionnaire. Table 4 presents mean values of the opinions by the respondents' answers to the questionnaire statements on the sources of energy and the renewable sources of energy, government support measures, awareness and promotion.

The respondents' opinions mean values of the individual variables are the highest for solar energy, which has a great development tendency, but in use it still has a relatively small share (solar energy), fuels for transport significantly contribute to the air pollution (transport) – and education activities give me an understanding of sustainable development in the context of climatic changes and energy needs (education activities). The modest mean values are found for the feasibility of 25% of renewable sources of energy by 2020 which represent a realistic objective (feasibility); the utilisation and use of wood biomass as well as its manufacturing into bio-fuels is increasing in importance and it is suitably arranged (biomass); the energy of wind in Slovenia can be used more for the energy purposes (wind energy); the potential of geothermal energy is used more and more for heating pumps (geothermal energy); fossil fuels – liquid fuel, gas, coil, and similar – will remain the base for the energy supply by 2020 (fossil fuels); the utilisation of hydro energy for large hydroelectricity plants on the Slovenian rivers has its future (hydroelectricity plants); the energy from agricultural production – biogas, bio-diesel, energy plants, and similar – will be more and more in use (energy from agriculture); the utilisation of energy from small hydroelectricity plants on small rivers in Slovenia is important (small hydroelectricity plants); the intensity of agricultural production is suitable (intensity in agriculture); the awareness of a more efficient use of energy is suitably arranged by the purchase prices for producers (awareness); industrial cogenerations are well established in co-production of heating and electric energy (co-production of energy); the sufficiency of 25% of renewable sources of energy is suitable by 2020 (sufficiency); the promotion of a more efficient use and for renewable sources of energy is covered by the media (promotion); ecological and environmental conditions that should be complied with for the construction of new energy sources are relatively simple (ecological conditions); the orientation of agriculture from the production of food also to the production for the needs of energy is balanced (food for energy); and nuclear energy is a real perspective for covering the needs for electric energy (nuclear energy). The lowest mean values are found for the variables of: the adoption of the Ecological-energy Package during the Slovenian Presidency of the EU is in the

consciousness of all citizens (ecological consciousness); subsidies for renewable sources of energy are arranged suitably by the guaranteed purchase prices for producers (subsidies); the use of chemical means is controlled suitably (chemical means), and fuel cells as an an alternative source of energy are reasonably well known (fuel cells). The results confirm high expectations regarding renewable sources of energy with the support of educational activities, but less with the support mechanisms. The most important alternative source of energy is seen in solar energy. Also important is the feasibility of 25% of renewable sources of energy by 2020. The low values for new technologies, as for example fuel cells, indicate that the new development opportunities for alternative sources of energy are not well known. This calls for

Table 4. Mean values for sources of energy and renewable sources of energy, support measures and awareness

	Statement	Variable	Mean value	SD
1	Fuels for transport significantly contribute to the air pollution	transport	4.10	1.02
2	Solar energy has great development tendency, but in use still a relatively small share	solar energy	4.24	1.01
3	Energy of wind in Slovenia can be used more for the energy purposes	wind energy	3.78	1.09
4	Education activities give me an understanding of sustainable development in the context of climatic changes and energy needs	education activities	3.98	1.01
5	Utilisation of hydro energy for large hydroelectricity plants on the Slovenian rivers has its future	hydroelectricity plants	3.71	1.05
6	Utilisation of energy from small hydroelectricity plants on small rivers in Slovenia is important	small hydroelectricity plants	3.66	1.10
7	Fossil fuels – liquid fuel, gas, coil, and similar – will remain the base for the energy supply by 2020	fossil fuels	3.75	1.16
8	Potential of geothermal energy is used more and more for heating pumps	geothermal energy	3.76	1.00
9	Nuclear energy is a real perspective for covering the needs for electric energy	nuclear energy	3.46	1.17
10	Industrial cogenerations are well established in co-production of heating and electric energy	co-production of energy	3.61	0.97
11	Energy from agricultural production – biogas, bio-diesel, energy plants, and similar – will be more and more in use	energy from agriculture	3.69	1.15
12	Utilisation and use of wood biomass as well as its manufacturing into bio-fuels is increasing in importance and is suitably arranged	biomass	3.80	1.15
13	Feasibility of 25% of renewable sources of energy by 2020 represents a realistic objective	feasibility	3.81	0.96
14	Ecological and environmental conditions that should be complied with for construction of new energy sources are relatively simple	ecological conditions	3.53	1.15
15	Sufficiency of 25% of renewable sources of energy is suitable by 2020	sufficiency	3.60	1.08
16	Promotion of more efficient use and for renewable sources of energy is covered by the media	promotion	3.57	1.04
17	Intensity of agricultural production is suitable	intensity in agriculture	3.64	1.07
18	Orientation of agriculture from production of food also towards production for the needs of energy is balanced	food for energy	3.52	1.19
19	Awareness of more efficient use of energy is suitably arranged by purchase prices for producers	awareness	3.63	1.07
20	Use of chemical means is suitably controlled	chemical means	3.39	1.25
21	Subsidies for renewable sources of energy are suitably arranged by the guaranteed purchase prices for producers	subsidies	3.40	1.08
22	Fuel cells as an alternative source of energy are reasonably well known	fuel cells	3.23	1.29
23	The adoption of the Ecological-energy Package during the Slovenian Presidency of the EU is in the consciousness of all citizens	ecological consciousness	3.41	1.27

Source: Survey results

the appropriate information and promotion activities on progress in the new advanced technologies, their positive impacts on the environment to establish consensus with the public societal preferences on a long-term strategy and instruments for the implementation of potentials and obligations for a 25% reduction of the green house gas emissions by 2020.

Table 5. Multivariate factor analysis for sources of energy and renewable sources of energy

	Maximum likelihood method – oblique rotation method with the Kaiser normalisation		
	structure matrix		
	1	2	3
Fossil fuels	0.325	**–0.633**	–0.069
Feasibility 25%	0.440	–0.337	0.403
Sufficiency 25%	**0.556**	–0.442	0.211
Nuclear energy	**0.528**	**–0.576**	**–0.526**
Transport	0.253	**–0.572**	0.280
Ecological conditions	**0.612**	–0.411	0.031
Wind energy	0.465	**–0.571**	0.244
Hydro energy	**0.514**	**–0.562**	0.010
Small hydro energy	0.433	–0.472	0.374
Solar energy	0.309	**–0.811**	0.131
Co-production	0.364	–0.399	0.390
Intensity in agriculture	0.470	**–0.532**	–0.244
Chemical means	**0.641**	–0.311	0.136
Energy from agriculture	0.495	**–0.545**	0.225
Food for energy	**0.654**	**–0.556**	0.192
Biomass	**0.643**	–0.475	–0.013
Geothermal energy	0.412	**–0.523**	–0.081
Fuel cells	**0.749**	–0.396	0.022
Subsidies	**0.615**	–0.384	0.185
Awareness	**0.702**	–0.300	–0.147
Consciousness	**0.703**	–0.168	0.059
Promotion	0.473	–0.317	0.013
Education activities	**0.535**	**–0.633**	–0.069

Cronbach ά factor 1 = 0.873, N = 10 (ecological consciousness, promotion, fuel cells, chemical means, biomass, subsidies, ecological conditions, food for energy, sufficiency of 25% objectives by 2020), Cronbach ά factor 2 = 0.818, N = 7 (nuclear energy, solar energy, intensity in agriculture, fossil fuels, geothermal energy, hydroelectricity plants, education activities), Cronbach ά factor 3 = 0.810, N = 8 (solar energy, small hydroelectricity plants, transport, co-production of energy for heating and for electric energy, wind energy, feasibility of 25% of renewable sources of energy by 2020, energy from agriculture, food for energy) or Cronbach ά factor 3 = 0.766, N = 6 (solar energy, small hydroelectricity plants, transport, co-production of energy for heating and for electric energy, wind energy, feasibility of 25% of renewable sources of energy by 2020)

The correlation analysis with the Pearson's correlation coefficient shows that the Pearson's partial correlation coefficient between the analyzed pairs of variables is greater than 0.5 for the correlation between: hydroelectricity plants and wind energy, awareness and fuel cells, ecological conditions and food for energy, nuclear energy and intensity in agriculture, ecological conditions and chemical means in agriculture, subsidies and fuel cells, biomass and fuel cells, ecological consciousness and awareness, food for energy and chemical means, subsidies and food for energy.

The Bartlett's test (approx. Chi-square 891.83, Sig. 0.000) and the KMO measure of sampling adequacy (0.80) confirm the suitability of the data for the multivariate factor analysis. The multivariate factor analysis confirms three common factors, which cumulatively explain 50.2% of the variance for the analyzed sample of variables: the first one explains 35.1% of variance, the second one an additional 8.1% of variance and the third one an additional 7% of variance. The Cranach's ά coefficient for each summated scale is above the 0.70 criteria.

The maximum likelihood with the oblique rotation method and the Kaiser normalisation strengthened the model with three common factors (Table 5). The coefficients of the structure matrix confirm the first common factor: the ecological-energy policy, rising awareness and promotion with the highest weights of the variables for fuel cells, ecological consciousness, awareness, food for energy, biomass, chemical means, subsidies, ecological conditions, sufficiency of 25% objectives by 2020, education activities, nuclear energy, hydroelectricity plants, and to a lesser extent energy from agricultural production (biogas, bio-diesel, energy plants, and similar). The second common factor is associated with the utilisation of natural potentials of the renewable sources of energy, which has the highest absolute weights in the variables for: solar energy, fossil fuels, education activities, nuclear energy, transport, wind energy, hydroelectricity plants, food for energy, energy from agriculture, intensity of agriculture, and geothermal energy. The third common factor is the nuclear energy, which has the highest weights in the variable for nuclear energy.

CONCLUSION AND POLICY IMPLICATIONS

The increasing growth in the energy use with the increasing emissions of CO_2 have been one of the reasons for the global warming and changing climatic

conditions since the mid-20th century (Stern 2007). The promotion of the competitive energy supply, the efficient energy use, a greater production and use of the renewable sources of energy are important directions in cutting down the greenhouse gas emissions to less than half of the current level, and for the development of a zero-emission social infrastructure through promoting the use of renewable sources of energy to stabilize the climate. This holds also for agriculture and rural areas for the energy use and the renewable energy production.

We have addressed the respondents' opinions on the issue of factors affecting societal preferences for the sustainable energy production and use, emphasising the energy use and the renewable energy production. We have presented the approximation of preferences on the basis of the opinions from the conducted unique in-depth surveys with the professional group in the natural sciences. However, in many cases the public opinion has only an indirect effect on the analysed issues of the competitive supply and the efficient energy use, the sources of energy and renewable sources of energy. The empirical findings of the respondents' opinions support the promotional activities and policies for the efficient production and a greater use of renewable sources of energy, focusing on agriculture and rural areas. Because the sample covers a narrow cluster of the society, the findings and conclusions are biased to these by the education background professional group.

The multivariate factor analysis of the respondents' opinions in the case of the competitive supply and the efficient energy use confirms three common factors: the first one has the highest weight in the variable under the common name of the price competitive supply of energy, with opportunities to choose the energy suppliers between various suppliers. The second one confirms the significance of energy costs for the economy, with the highest variable weights for electric energy in households, costs, energy in the economy, knowledge and emissions of CO_2. The third one confirms the sustainable energy supply development and the ecological perception of the alternative renewable sources of energy use, with importance of the variables for R&D, alternative sources of energy, knowledge and ecological consciousness.

Moreover, the multivariate factor analysis of the respondents' opinions on the sources of energy and the renewable sources of energy, the support measures and the raising public awareness on the sustainable development of energy identifies three common factors: the first one has the highest significance in the ecological-energy policies, raising the awareness and promotion with fuel cells, ecological consciousness, awareness, food for energy, biomass, chemical means, subsidies, ecological conditions, sufficiency of 25% objectives of renewable sources of energy by 2020, education activities, nuclear energy, hydroelectricity plants, and to a lesser extent, the energy from agricultural production. The second one on the utilisation of the natural renewable potentials as the sources of energy, which has the highest variable weights for solar energy, fossil fuels, education activities, nuclear energy, transport, wind energy, hydroelectricity plants, food for energy, energy from agriculture, intensity in agriculture, and geothermal water. The third common factor is the nuclear energy, which has the highest weights in the variable for nuclear energy. The respondents' opinions realise the expectations from R&D of new advanced solutions and technologies in making shifts to the sustainable energy supplies on more environmentally friendly ways with less environmental pollution. The use of energy in sustainable living can have implications for the use of scarce resources and on environment as a reason for measures of a more efficient energy use. The respondents' opinions reveal that the differences in competitiveness of suppliers are still not sufficiently pronounced. There is an awareness of the CO_2 gas emissions, the needs for energy and its efficient use and the costs for its use. Yet a consistently low importance is placed on the prices of energy and competitiveness.

As being important for a more competitive supply, the efficient energy use and the sustainable energy development, the respondents' opinions are seen in the competitive market developments with the opportunities to choose among different suppliers, in education activities giving an understanding of sustainable development in the context of climatic changes and energy needs and the promotion activities for the sustainable energy development and the use of renewable sources of energy. The respondents' opinions on the sources of energy and renewable sources of energy imply the increased support of the community, media and an increase in the awareness of the state structures, education and promotion activities, and the support for renewable energy sources, particularly for the creation of public opinion. Among the natural potentials of the renewable sources of energy in the management of technology, and as a step towards a more sustainable production, the greatest potentials are seen in the production and use of solar energy, water resources, wind, biogas, biomass energy as well as in some areas, of geothermal water.

The respondents' opinions on the promotion of the renewable sources of energy use and the renewable energy production in agriculture are expectedly positive, where an important role is played by the policies and support measures towards the promo-

tion of the production and use of renewable sources of energy from agriculture. The promotion and education activities have an important role in the dissemination of knowledge on a more efficient energy use and on a greater supply and use of energy from the renewable sources of energy, including those from agriculture. A more efficient energy use and the significance of production of renewable sources of energy from different sources in agriculture have implications for the green energy supply management from agriculture and environmental protection that consider potentials both for a more efficient use of energy and for a greater production and use of energy from the renewable sources of energy. In the light of the objective to achieve a 20 per cent share of the production of electric energy from the renewable sources of energy by 2020, an important role is also given to an improvement in knowledge, understanding and in the public opinion for the promotion of a more efficient energy use and an improvement in the use of the renewable sources of energy in sustainable development. During the last years, with policy shifts, in Slovenia there is an increase in the biogas and solar electricity plants in agricultural households for the production of electric and other energy and for heating. The most significant developments are some biogas equipments for the electricity and energy production and for heating on large-scale pig and some other farms, and solar electricity plants on the roofs of agricultural buildings. These are also challenging issues for the future research on the relations between agriculture, ecology, energy, and sustainable agricultural and rural development.

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