**118th EAAE Seminar**

**"Rural development: governance, policy design and delivery"**

**Ljubljana, 25-27 August 2010**

# PROMOTION OF RENEWABLE SOURCES OF ENERGY FROM RURAL AREAS

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***Paper prepared for presentation at the 118th seminar of the EAAE (European Association of Agricultural Economists), 'Rural development: governance, policy design and delivery' Ljubljana, Slovenia, August 25-27, 2010***

# PROMOTION OF RENEWABLE SOURCES OF ENERGY FROM RURAL AREAS


## ABSTRACT

This paper investigates the question of promotion of more efficient use of energy and for an increase in supply and use of energy from the renewable sources of energy in rural areas. The empirical research is based on the analysis of the survey evidence that is obtained by the written questionnaire. The 516 in-depth surveys were conducted among the scholars, students, and employees from social sciences, natural sciences, electrical energy supply, and energy management in the six different towns in Slovenia. The surveys data are analysed by using descriptive statistics, comparisons of average values, correlation, and multivariate factor analysis. The needs for more efficient energy use between different users and the significance of production of renewable sources of energy from different sources have been confirmed. This has implications for rationalization of energy supply, efficient energy use and use of the renewable sources of energy for more underlined environmental protection and the sustainable development.



**KEYWORDS:** renewable sources of energy, rural development, promotion, Slovenia

JEL classification: L94; 013; Q42; M39


## 1. INTRODUCTION

Among strategic objectives in the European Union (EU) member states in the field of the energy sector are objectives to improve efficiency in energy uses and to increase the use of renewable sources of energy. We want to investigate in what extent energy users are informed on competitive energy supply, on more efficient energy uses, on potentials to increase production and use of renewable sources of energy particularly in rural areas. We expect that an important role in dissemination of knowledge on more efficient energy use and on a greater use of renewable sources of energy have promotion and education activities towards more efficient use of energy and towards an increase in supply and use of energy from the renewable sources of energy with contributions from rural areas.

The business interests of suppliers of energy can be in contradiction with an efficient use of energy and development of alternative, renewable sources of energy, which at the same times have effects on environment and competitiveness (Nordhaus, 1994; Fussler, 2002; Stern, 2007; Wagner et al., 2007). Competitive supply of energy is also related to developments on international energy markets such as for example on the world oil market price oscillations. Literature on ecological management and sustainable development (Graedel, 1996; Roome, 2001) in entrepreneurial strategies of enterprises (Sinding, 2000) includes sustainable components in economic growth (Priemus, 1994). This is broader than only positive effects of technological changes and development of sustainable technologies (Weaver et al., 2000) and their positive externalities in economic growth (Samuelson and Nordhaus, 2002) and for an efficient use (Segger, 1999) and management with primary products (Barbiroli, 1984). Different activities can have different implications for the energy sector and on environment and sustainable development (Frosch and Gallopoulos, 1989).

In this paper we focus on competitive supply, efficient use of energy, and development and use of renewable sources of energy particularly from rural areas. We present findings of our research on the promotion of the competitive supply, efficient use, and on use of renewable sources of energy. The awareness and knowledge on this by different professional groups can be considerably improved by promotional activities to provide information, knowledge, awareness, and public opinions on efficient energy use and use of renewable sources of energy in sustainable development. The focus is on the analysis and presentation of the opinions that are obtained by the surveys among four different professional groups in Slovenia on questions on promotion of competitive energy supply, more efficient use of energy, and on greater importance of the renewable sources of energy with implications for rural areas.

## 2. METHODOLOGY

The unique survey data are analysed by using descriptive statistics and mean values to compare different perceptions by professional structures in our survey, correlation analysis, and multivariate factor analysis. The opinion differentials by professional groups are tested to compare mean values of independent samples.

The correlation coefficient 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 variable can be dependent on third factor, which might be not known. Due to this we will also use multivariate factor analysis, which will show the most important common factors and their weights, which are important for explanation of the analysed phenomena (Kachigan, 1991).

We test the following two hypotheses:

H1: the opinions by the respondents are biased to the type of their professional education and their specific and interdisciplinary knowledge on energy.

H2: The opinions of the respondents on the promotion of renewable sources of energy from rural areas are biased to the professional education with specific knowledge and understanding of policies and measures for promotion of renewable sources of energy from rural areas.

The written questionnaire was agreed with the Slovenian Ministry of Environment and Territory. The surveys were conducted on the basis of the prepared written questionnaire in June and July 2008. In the survey were included students and employees of the Faculty of Management Koper at the University of Primorska, among employees and scholars of the final generation of the Secondary Biotechnical School and first year generation of the students of Higher School of the Biotechnical Centre Naklo, and among employees and graduates of Higher School for Electro-techniques of Education Centre of Energy System of Slovenia. Among energy management we conducted the surveys between July and September 2008. The questionnaire was published in the journal EGES and with the on-line publication of the questionnaire on the website http://em.com.hr/misc/ove_2020.

We aim to underline more efficient energy use between different users and the significance of production of renewable sources of energy from different sources with implications for rationalization of energy supply management and for more underlined environmental protection and on a greater role of renewable sources of energy from rural areas. We also evaluate our results in a light of the objective to achieve 20 per cent share of production of electrical energy from the renewable sources of energy by 2020.

## 3. DATA

The empirical research is based on the analysis of the survey evidence obtained by the written questionnaire. The surveys were conducted among scholars, students, and employees in social sciences, in natural sciences, in electrical energy supply, and in energy management in different levels of education and in different enterprises. Among the employees and students of the Faculty of Management at the University of Primorska were distributed 300 questionnaires and 180 (60%) were returned in the completed form. Between the employees and scholars of the final years at the Secondary Biotechnical School and the first generation of Higher School of Biotechnical Centre Naklo were distributed 130 questionnaires and 83 (64%) were returned in the completed form. Among the graduates of the Higher School for Energetic of the Education System of the Electro-energetic of Slovenia were distributed 800 questionnaires and 136 (17%) were returned in the completed form. Among energy management, which are readers of the expert journal in the area of energy, economy and ecology (journal EGES) and among visitors of the website http://em.com.hr/misc/ove_2020 there was 117 questionnaires completed. In total, we have conducted 516 in-depth surveys by the use of the written questionnaire in Ljubljana, Koper, Celje, Škofja Loka, Nova Gorica, and Naklo in Slovenia.

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

| *Structure* | *Group* | *Social sciences* | *Natural sciences* | *Electrical energy* | *Energy mana-gement* | *Total* |
|---|---|---|---|---|---|---|
| *Gender (%)* | *Man* | 40.0 | 32.5 | 98.5 | 68.4 | 60.7 |
| | *Women* | 60.0 | 67.5 | 1.5 | 31.6 | 39.3 |
| *Age (%)* | *up to 24 years* | 50.0 | 63.9 | 2.2 | 11.1 | 30.8 |
| | *25 to 29 years* | 23.3 | 2.4 | 5.1 | 12.8 | 12.8 |
| | *30 to 34 years* | 11.7 | 10.8 | 16.2 | 19.7 | 14.5 |
| | *35 to 39 years* | 3.9 | 2.4 | 22.1 | 10.3 | 9.9 |
| | *40 to 44 years* | 5.6 | 7.2 | 25.0 | 9.4 | 11.8 |
| | *45 to 49 years* | 3.9 | 8.4 | 19.1 | 7.7 | 9.5 |
| | *50 to 55 years* | 1.1 | 3.6 | 8.8 | 17.9 | 7.4 |
| | *Over 55 years* | 0.6 | 1.2 | 1.5 | 11.1 | 3.3 |
| *Average age (years)* | | 28.8 | 35.4 | 40.2 | 39.4 | 34.4 |
| *Education (%)* | *Secondary* | 22.2 | 56.6 | 0.0 | 6.0 | 18.2 |
| | *Higher* | 13.3 | 16.9 | 92.6 | 6.8 | 33.3 |
| | *College.* | 12.2 | 3.6 | 6.6 | 17.9 | 10.7 |
| | *Bologna I.* | 14.4 | 0.0 | 0.0 | 4.3 | 6.0 |
| | *University* | 19.4 | 21.7 | 0.0 | 34.2 | 18.0 |
| | *Specialist* | 11.1 | 0.0 | 0.0 | 8.5 | 5.8 |
| | *Bologna II* | 2.2 | 0.0 | 0.0 | 0.9 | 1.0 |
| | *Scientific master* | 3.9 | 1.2 | 0.7 | 16.2 | 5.4 |
| | *Doctorate* | 1.1 | 0.0 | 0.0 | 5.1 | 1.6 |
| *Average completed years of schooling* | | 14.8 | 13.4 | 14.1 | 16.0 | 14.7 |

Source: Survey results.

By gender, in the groups of social and natural sciences, the majority of the included in our sample are women, whereas men in the groups of electrical energy and energy management (Table 1). The age structure is biased to the sample selection. By age, in the group of social sciences the most important single group is up to 24 years. By the age structure similar is the group for natural sciences, which includes also secondary scholars. In the groups of the electrical energy and energy management are in a greater extent included employees of middle-age generation.

By level of education, in the group of social sciences there are prevailing university graduates and master students. For electrical energy, the prevailing is higher school, for natural sciences there is important secondary school, and for energy management there is important university degree and to a lesser extend post-graduate degree. By the average years of the completed schooling, on the first place is the group of energy management, followed by the groups of social sciences, electrical energy, and at the end the group of natural sciences.

## 4. EMPIRICAL RESULTS

### 4.1. Competitive supply and efficient energy use

The written questionnaire on competitive supply in electro-energy system and on 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 mean values differ by the professional groups, which is consistent to our H1 expectation. For total sample, the highest mean values are for the variables energy in the economy, alternative sources, of energy, efficient energy use, knowledge, and research and development (R&D). The modest mean values are found for $CO_2$ gas emissions, ecology, electricity in households, progress, and costs (Table 2). The lowest mean values are found for prices of electricity in households, competitiveness, and prices of energy.

There are higher expectations from R&D in development of new advanced solutions and technologies to contribute to energy supplies on more environmentally friendly ways with less environmental pollutions. The use of energy has implications on environment as a reason for measures of more efficient use of energy. The differences in competitiveness of suppliers are not enough pronounced. By education background, in the social science group there is high support for energy in the economy, alternative sources of energy, and R&D. This is also confirmed by the energy management group, which together with the electro-energy group give importance to knowledge and efficient energy use. The natural science group is aware of $CO_2$ gas emissions, needs for energy and its efficient use and costs for its use. It is rather consistent low importance on prices of energy and competitiveness.

The correlation analysis shows direction and intensity of association between analyzed pairs of variables. The highest correlation coefficient for the social science group is between efficient energy use and ecology. For the other analyzed groups the correlation coefficients are less than 0.5 implying that the partial correlations between the pairs of variables are less pronounced.

The multivariate factor analysis model is estimated in two steps. In the first step, we estimate the shares of explained variance of the analyzed variables with the common factors/communalities by the principal axis factoring and by the maximum likelihood method. In the second step, we estimate the factor weights with different rotation methods. The scree plot on the number of common factors confirms three common factors. The explained variance by using thirteen variables is 47.4%.

The principal axis factoring confirms the three common factors: first, the sustainable development in efficient energy use with the highest weights in ecology, R&D, knowledge, efficient energy use, $CO_2$ gas emissions, energy in the economy, alternative sources of energy, electricity in households, costs, and progress (Table 3). The second common factor is the energy competitiveness of the economy, which has the highest weights in price of energy, price of electricity in households, and competitiveness. The third common factor is the price competitiveness of supply with energy, which has the highest weights in costs and energy for the economy.

**Table 2.** Summary statistics of the variables competitive supply and efficient use of energy by professional groups

| | Social sciences | | Natural sciences | | Electrical energy | | Energy management | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| Variables | Mean value | SEE | Mean value | SEE | Mean value | SEE | Mean value | SEE | Mean value | SEE |
| Progress | 4.05 | .060 | 4.07 | .104 | 4.29 | .068 | 4.11 | .091 | 4.13 | .038 |
| Costs | 4.02 | .066 | 4.19 | .099 | 4.25 | .072 | 3.96 | .086 | 4.09 | .039 |
| Energy in economy | 4.41 | .058 | 4.28 | .102 | 4.47 | .063 | 4.27 | .081 | 4.37 | .036 |
| Electricity in household | 4.15 | .072 | 4.17 | .110 | 4.26 | .075 | 4.16 | .085 | 4.18 | .041 |
| Price of electricity in households | 2.59 | .085 | 2.73 | .145 | 3.22 | .093 | 3.04 | .116 | 2.88 | .053 |
| Price of energy | 3.14 | .073 | 3.22 | .112 | 3.24 | .081 | 3.05 | .101 | 3.16 | .044 |
| Competitiveness | 3.36 | .085 | 3.47 | .125 | 2.69 | .103 | 2.86 | .108 | 3.09 | .053 |
| Efficient use | 4.13 | .073 | 4.18 | .109 | 4.57 | .054 | 4.54 | .067 | 4.35 | .038 |
| Ecology | 4.07 | .072 | 4.02 | .115 | 4.37 | .067 | 4.34 | .078 | 4.20 | .040 |
| CO2 | 4.18 | .066 | 4.30 | .098 | 4.32 | .075 | 4.32 | .080 | 4.27 | .039 |
| Alternative sources | 4.36 | .062 | 4.08 | .117 | 4.50 | .065 | 4.42 | .084 | 4.36 | .039 |
| Knowledge | 4.14 | .069 | 3.88 | .126 | 4.70 | .047 | 4.56 | .065 | 4.34 | .039 |
| R&D | 4.24 | .062 | 3.87 | .123 | 4.43 | .069 | 4.44 | .070 | 4.28 | .039 |

SEE – standard error of estimate. Each t-test significant (2-tailed) at 1%.

**Table 3.** Competitive supply and efficient energy use (matrices of five different extraction methods with three components extracted)

| | Principal axis factoring[a] | | | Maximum likelihood method[b] | | | Maximum likelihood method – Oblimin with Kaiser normalization[c] | | | Maximum likelihood method – Oblimin with Kaiser normalization | | | Maximum likelihood method – Varimax with Kaiser normalization [d] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Factor Matrix | | | Factor Matrix | | | Pattern Matrix | | | Structure Matrix | | | Rotated Factor Matrix | | |
| | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| Progress | .350 | -.023 | .107 | .353 | -.009 | .099 | .138 | .077 | .245 | .282 | .185 | .330 | .204 | .281 | .118 |
| Costs | .483 | -.173 | .444 | .493 | -.095 | .452 | -.069 | .064 | .689 | .281 | .205 | .672 | .107 | .658 | .110 |
| Energy in economy | .494 | -.338 | .383 | .501 | -.242 | .436 | .003 | -.091 | .722 | .313 | .083 | .701 | .156 | .689 | -.028 |
| Electricity in household | .490 | -.085 | .136 | .490 | -.084 | .137 | .218 | .033 | .363 | .401 | .197 | .474 | .299 | .409 | .097 |
| Price of electricity in households | .217 | .313 | .035 | .224 | .312 | -.048 | .079 | .367 | -.056 | .182 | .381 | .069 | .128 | .009 | .366 |
| Price of energy | .268 | .676 | .247 | .300 | .721 | .085 | -.141 | .827 | -.018 | .143 | .773 | .114 | .009 | .047 | .784 |
| Competitiveness | .282 | .298 | .139 | .294 | .307 | .055 | .030 | .389 | .079 | .205 | .419 | .187 | .117 | .130 | .392 |
| Efficient use | .516 | -.001 | -.285 | .517 | -.082 | -.313 | .652 | -.018 | -.086 | .605 | .192 | .219 | .600 | .074 | .077 |
| Ecology | .611 | .005 | -.322 | .605 | -.095 | -.340 | .738 | -.017 | -.074 | .697 | .226 | .272 | .686 | .106 | .093 |
| CO2 | .516 | -.044 | -.040 | .504 | -.088 | -.043 | .395 | .008 | .186 | .486 | .193 | .376 | .423 | .278 | .086 |
| Alternative sources | .491 | .029 | -.200 | .481 | -.038 | -.205 | .514 | .034 | -.004 | .524 | .214 | .248 | .497 | .126 | .113 |
| Knowledge | .554 | -.035 | -.123 | .544 | -.075 | -.119 | .487 | .020 | .121 | .551 | .221 | .357 | .498 | .238 | .106 |
| R&D | .592 | -.014 | -.154 | .580 | -.049 | -.145 | .525 | .052 | .100 | .591 | .261 | .361 | .535 | .231 | .141 |

[a] 25 iterations, [b] 9 iterations, [c] Rotation in 6 iterations, [d] Rotation in 5 iterations.

Cronbach ά factor 1 = 0.749, N=6 (ecology, efficient use of energy, R&D, knowledge, alternative sources of energy, $CO_2$ gas emissions). Cronbach ά factor 2 = 0.631, N=3 (energy in economy, costs and electricity in households). Cronbach ά factor 3 = 0.478, N=3 (price of energy, competitiveness and price of electricity in households).

The maximum likelihood method without rotation also confirms the three common factors: first, the sustainable development of efficient energy use with the highest weights in ecology, R&D, knowledge, efficient energy use, $CO_2$ gas emissions, energy in the economy, costs, electricity in households, alternative sources of energy, and progress. The second common factor is the energy competitiveness in the economy, which has the highest weights in price of energy, price of electrical energy in households, and competitiveness. The third common factor is the price competitiveness of supply with energy, which has the highest weights in costs and energy in the economy.

The maximum likelihood with Oblimin method and Kaiser normalization strengthens the estimations and confirms the stability of the three common factors: the first on the sustainable development in the efficient use of energy, which has the highest weights in ecology, efficient use of energy, R&D, knowledge, alternative sources of energy, $CO_2$ gas emissions, and electricity in households. The second common factor is the energy competitiveness in the economy, which has the highest weights in price of energy, price of electrical energy in households, and competitiveness. The third common factor is the price competitiveness with supply of energy, which has the highest weights in energy in the economy, costs, electricity energy in households, $CO_2$ gas emissions, R&D, knowledge, and progress.

The maximum likelihood with Varimax method and Kaiser normalization also confirms the stability of the models. The first common factor is the sustainable development in efficient use of energy, which has the highest weights in ecology, efficient energy use, R&D, knowledge, alternative sources of energy, and $CO_2$ gas emissions. The second common factor is the energy competitiveness in the economy, which has the highest weights in energy in the economy, costs, and electrical energy in households. The third common factor is the price competitiveness with supply of energy, which has the highest weights in price of energy, competitiveness, and price of electrical energy in households.

From the point of view of competitive supply and efficient energy use, the results are in a favour of sustainable development in efficient energy use, which is based on implementation of ecological knowledge for R&D of alternative sources of energy. This is reflected in efficient energy supply with reduction of $CO_2$ gas emissions. R&D and knowledge have from point of view of the energy competitiveness in the economy modest weights. The modest are also weights for alternative sources of energy and ecology in the price competitiveness with energy supply, which imply that alternative source of energy are more likely not enough to exploit economies of scale in competitive supply of energy, and thus is important efficient use of energy.

### 4.2. Renewable sources of energy

The written questionnaire on renewable sources of energy contains 23 questions by the Likert scale ranged from 1 (not important) up to 5 (very important). As expected according to the H1 and H2, the mean values are biased to the professional education (Table 4). In general, the mean values of the individual variables are the highest for transport, solar energy, wind energy, education, hydro electricity plants, and small hydro electricity plants. The modest mean values are find for fossil fuels, geothermal energy, nuclear energy, co-production of energy, energy from agriculture, biomass, feasibility of 25% of renewable sources of energy, ecological conditions, sufficiency of 25% of renewable sources of energy, promotion, intensity in agriculture, and food for energy. The lowest mean values are found for variables awareness, chemical means, subsidies, fuel cells, and consciousness. The results confirm high expectations regarding renewable sources of energy with support of education activities, but less with support mechanisms. By professional education, the social science, electro-energy, and energy management groups see as the most important alternative sources of energy in solar and wind energy. The latter is less important for the natural science group. Moreover, the social science group gives greater importance to conventional fossil sources, whereas the electrical energy group gives greater importance to large and small hydro-electricity plants, whereas the energy management and natural sciences groups to education. For the natural science group is find important the feasibility of 25% of renewable sources of energy by 2020, the electrical energy group is the most sceptical about the feasibility of this objective. The low values for new technologies as for example fuel cells indicate that the new development opportunities on alternative sources of energy are not well known by the public outside the electro energy group.

**Table 4.** Summary statistics of the variables renewable sources of energy by professional groups

| | Social sciences | | Natural sciences | | Electrical energy | | Energy management | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| Variable | Mean value | SEE | Mean value | SEE | Mean value | SEE | Mean value | SEE | Mean value | SEE |
| Fossil fuels | 3.93 | .066 | 3.75 | .127 | 3.22 | .081 | 4.03 | .080 | 3.74 | .044 |
| Feasibility 25% | 3.75 | .073 | 3.81 | .105 | 3.13 | .073 | 3.61 | .100 | 3.56 | .044 |
| Sufficiency 25% | 3.56 | .077 | 3.60 | .119 | 3.19 | .080 | 3.20 | .105 | 3.39 | .046 |
| Nuclear energy | 3.49 | .074 | 3.46 | .129 | 4.15 | .069 | 3.67 | .108 | 3.70 | .047 |
| Transport | 4.35 | .070 | 4.10 | .112 | 4.50 | .063 | 4.55 | .070 | 4.39 | .038 |
| Ecological conditions | 3.40 | .085 | 3.53 | .126 | 3.61 | .099 | 3.06 | .125 | 3.40 | .053 |
| Wind energy | 4.11 | .074 | 3.78 | .120 | 4.24 | .086 | 3.63 | .122 | 3.98 | .049 |
| Hydro energy | 3.77 | .071 | 3.71 | .116 | 4.19 | .078 | 3.78 | .100 | 3.87 | .044 |
| Small hydro energy | 3.79 | .075 | 3.66 | .120 | 4.05 | .089 | 3.79 | .110 | 3.84 | .048 |
| Solar energy | 4.24 | .066 | 4.24 | .111 | 4.52 | .059 | 4.24 | .091 | 4.31 | .039 |
| Co-production | 3.61 | .068 | 3.61 | .107 | 3.82 | .076 | 3.62 | .099 | 3.67 | .042 |
| Intensity in agriculture | 3.28 | .078 | 3.64 | .117 | 3.71 | .077 | 2.81 | .096 | 3.35 | .047 |
| Chemical means | 3.04 | .098 | 3.39 | .137 | 3.60 | .080 | 2.55 | .123 | 3.13 | .056 |
| Energy from agriculture | 3.69 | .072 | 3.69 | .126 | 3.70 | .092 | 3.39 | .095 | 3.63 | .046 |
| Food for energy | 3.35 | .080 | 3.52 | .131 | 3.59 | .103 | 2.79 | .115 | 3.31 | .053 |
| Biomass | 3.48 | .070 | 3.80 | .126 | 4.01 | .079 | 3.11 | .094 | 3.59 | .046 |
| Geothermal energy | 3.57 | .071 | 3.76 | .109 | 4.15 | .071 | 3.41 | .092 | 3.72 | .043 |
| Fuel cells | 3.00 | .088 | 3.23 | .142 | 3.21 | .098 | 2.75 | .130 | 3.03 | .055 |
| Subsidies | 3.18 | .084 | 3.40 | .119 | 2.94 | .093 | 2.88 | .113 | 3.09 | .050 |
| Awareness | 3.23 | .092 | 3.63 | .117 | 3.21 | .093 | 2.80 | .122 | 3.19 | .054 |
| Consciousness | 3.32 | .087 | 3.41 | .139 | 2.81 | .095 | 2.35 | .111 | 2.98 | .055 |
| Promotion | 3.50 | .079 | 3.57 | .114 | 3.31 | .092 | 3.01 | .103 | 3.35 | .048 |
| Education | 3.76 | .078 | 3.98 | .111 | 4.07 | .085 | 3.89 | .098 | 3.91 | .046 |

SEE – standard error of estimate. Each t-test significant (2-tailed) at 1%.

This calls for appropriate information and promotion on progresses in new advanced technologies, their positive impacts on environment to establish consensuses with the public on a long-term strategy and instruments for implementation of potentials and obligations about 25% reduction of gas emissions by 2020. The supply and use as well as promotion of renewable sources of energy from rural areas gain less importance as a challenging issue in future rural development.

The correlation analysis shows direction and intensity of association between the analyzed pairs of variables. The partial correlation coefficients confirm rather modest associations between the analyzed variables. Greater than 0.5 is the correlation coefficient between consciousness and promotion, awareness and subsidies, consciousness and awareness, intensity in agriculture and use of chemical means, hydroelectricity plants and small hydroelectricity plants, food for energy and use of chemical means, and between awareness and promotion.

**Table 5.** Sources of energy and renewable sources of energy (matrices of five different extraction methods with three components extracted)

| | Principal axis factoring[a] | | | Maximum likelihood method[b] | | | Maximum likelihood method – Oblimin with Kaiser normalization[c] | | | Maximum likelihood method – Oblimin with Kaiser normalization | | | Maximum likelihood method – Varimax with Kaiser normalization [d] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Factor Matrix | | | Factor Matrix | | | Pattern Matrix | | | Structure Matrix | | | Rotated Factor Matrix | | |
| Factors | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| Fossil fuels | .117 | .214 | .456 | .110 | .260 | -.389 | -.050 | .028 | -.480 | .027 | .113 | -.479 | -.023 | .070 | .475 |
| Feasibility 25% | .333 | .256 | .580 | .333 | .377 | -.573 | .076 | .078 | -.724 | .207 | .265 | -.752 | .119 | .172 | .733 |
| Sufficiency 25% | .451 | .108 | .428 | .452 | .194 | -.378 | .284 | .060 | -.486 | .374 | .275 | -.539 | .309 | .171 | .510 |
| Nuclear energy | .198 | .031 | .010 | .190 | .029 | .054 | .137 | .106 | .017 | .176 | .155 | -.025 | .152 | .130 | .004 |
| Transport | .197 | .340 | .077 | .168 | .345 | .001 | -.090 | .351 | -.148 | .066 | .348 | -.212 | -.018 | .340 | .177 |
| Ecological conditions | .490 | .026 | .039 | .488 | .070 | -.016 | .368 | .174 | -.102 | .449 | .338 | -.190 | .394 | .257 | .146 |
| Wind energy | .340 | .409 | -.089 | .305 | .417 | .138 | -.033 | .530 | -.061 | .180 | .531 | -.172 | .066 | .518 | .113 |
| Hydro energy | .397 | .413 | -.128 | .358 | .407 | .191 | .014 | .566 | -.014 | .235 | .574 | -.139 | .116 | .558 | .073 |
| Small hydro energy | .394 | .397 | -.133 | .358 | .405 | .168 | .017 | .551 | -.035 | .235 | .565 | -.157 | .117 | .546 | .093 |
| Solar energy | .393 | .438 | -.156 | .349 | .424 | .227 | -.008 | .600 | .015 | .222 | .594 | -.114 | .100 | .584 | .046 |
| Co-production | .474 | .046 | -.014 | .463 | .103 | .033 | .321 | .226 | -.064 | .417 | .364 | -.157 | .357 | .295 | .111 |
| Intensity in agriculture | .543 | .026 | -.179 | .530 | .053 | .240 | .395 | .321 | .143 | .499 | .442 | .018 | .436 | .380 | -.079 |
| Chemical means | .600 | -.127 | -.118 | .601 | -.067 | .134 | .544 | .168 | .078 | .598 | .361 | -.034 | .557 | .269 | -.020 |
| Energy from agriculture | .462 | .230 | -.079 | .437 | .268 | .124 | .181 | .421 | -.035 | .348 | .499 | -.152 | .253 | .453 | .092 |
| Food for energy | .680 | -.017 | -.129 | .676 | .034 | .148 | .538 | .285 | .044 | .642 | .484 | -.092 | .575 | .386 | .026 |
| Biomass | .628 | -.008 | -.175 | .618 | .026 | .198 | .490 | .294 | .102 | .590 | .461 | -.030 | .527 | .378 | -.035 |
| Geothermal energy | .513 | .067 | -.090 | .502 | .108 | .118 | .343 | .292 | .011 | .454 | .422 | -.100 | .386 | .355 | .045 |
| Fuel cells | .563 | -.200 | .001 | .578 | -.161 | -.008 | .599 | -.006 | -.019 | .600 | .229 | -.101 | .584 | .120 | .063 |
| Subsidies | .587 | -.306 | .060 | .617 | -.260 | -.073 | .704 | -.123 | -.049 | .663 | .160 | -.120 | .667 | .031 | .089 |
| Awareness | .645 | -.460 | .083 | .683 | -.402 | -.099 | .858 | -.249 | -.029 | .766 | .089 | -.093 | .794 | -.062 | .067 |
| Consciousness | .617 | -.320 | .051 | .646 | -.264 | -.082 | .732 | -.125 | -.059 | .692 | .171 | -.134 | .694 | .036 | .101 |
| Promotion | .575 | -.253 | .105 | .600 | -.210 | -.117 | .660 | -.109 | -.106 | .633 | .169 | -.174 | .629 | .042 | .144 |
| Education | .395 | -.075 | -.019 | .401 | -.067 | .029 | .383 | .056 | .003 | .404 | .204 | -.062 | .383 | .134 | .031 |

[a] 13 iterations, [b] 6 iterations, [c] Rotation in 8 iterations, [d] Rotation in 5 iterations.

Cronbach ά facto r 1 = 0 867, N=14 (sufficiency 25%, ecological conditions, co-production, intensity in agriculture, chemical means, food for energy, biomass, geothermal energy, fuel cells, subsidies, awareness, consciousness, promotion, education). Cronbach ά factor 2 = 0.768, N=8 (wind energy, hydro energy, small hydro energy, solar energy, energy from agriculture, food for energy, biomass, geothermal energy). Cronbach ά factor 3 = 0.627, N=3 (fossil fuels, feasibility 25%, sufficiency 25%).

The multivariate factor analysis confirms three common factors, which cumulatively explain 42.1% of the variance for the analyzed sample of variables. The principal axis factoring confirms three common factors. The first common factor is awareness, education, promotion and support for energy sources, which has the highest weights in food for energy, awareness, biomass, consciousness, chemical means, promotion, fuel cells, co-production of energy, energy from agriculture, intensity in agriculture, ecological conditions, and feasibility of 25% of renewable sources of energy by 2020 (Table 5). The second common factor is natural potentials of renewable sources of energy, which has the highest weights in solar energy, hydroelectricity plants, wind energy, and small hydroelectricity plants. The third common factor is fossil fuels and implementation of obligations, which has the highest weights in feasibility of 25% of renewable sources of energy by 2020, fossil fuels, and sufficiency of 25% objectives by 2020.

The maximum likelihood method without rotation also confirms the common factors. The first common factor is awareness, education, promotion and support for energy sources, which has the highest weights in awareness, food for energy, biomass, subsidies, chemical means, promotion, fuel cells, intensity in agriculture, geothermal energy, ecological conditions, co-production of energy, energy from agriculture, and education. The second common factor is natural potentials of renewable sources of energy, which has the highest weights in solar energy, wind energy, hydro electrical plants, and small hydro electrical plants. The third common factor is fossil fuels and implementation of obligations, which has negative direction of causalities. The highest weight has feasibility of 25% of renewable sources of energy by 2020, fossil fuels, and sufficiency of 25% objectives by 2020.

The maximum likelihood with Oblimin method and Kaiser normalization again strengthened the model and revealed its stability. The coefficient of the structure matrix confirms the first common factor awareness, education, promotion and support for energy sources with highest weights on awareness, consciousness, food for energy, subsidies, promotion, fuel cells, chemical means, biomass, intensity in agriculture, geothermal energy, co-production of energy, education, and energy from agriculture. The second common factor is associated with natural potentials of the renewable sources of energy, which has the highest weights in solar energy, hydroelectricity plants, small hydroelectricity plants, and wind energy. The third common factor is fossil fuels and implementation of obligations, which has negative direction of causalities. The highest weight has again been confirmed by the feasibility of 25% of renewable sources of energy by 2020, fossil fuels, and sufficiency of 25% objectives by 2020.

The maximum likelihood with Varimax method and Kaiser normalization also confirms three common factors. The first is awareness, education, promotion and support fro energy sources, which has the highest weights awareness, consciousness, subsidies, promotion, food for energy, fuel cells, chemical means, biomass, intensity in agriculture, ecological conditions, geothermal energy, education, and co-production of energy. The second common factor is associated with natural potentials of renewable sources of energy, which has the highest weights in solar energy, hydroelectricity plants, small hydroelectricity plants, and wind energy. The third common factor is fossil fuels and implementation of obligations, which has now positive direction of causalities. The highest weight has again been confirmed by the feasibility of 25% of renewable sources of energy by 2020, sufficiency of 25% objectives by 2020, and fossil fuels.

The sources of energy and renewable sources of energy imply the support for awareness, education, promotion, and support for energy sources, particularly for creation of public opinion. Among natural potentials of renewable sources of energy have the greatest potentials solar energy, water resources, wind, and biomass. They also provide entrepreneurial opportunities for rural areas.

## 5. CONCLUSION

One of strategic objectives in the EU member states in the field of the energy sector is to improve efficiency in energy use and to increase the use of renewable sources of energy. We investigate in what extent energy users are informed on competitive energy supply and on potentials to increase production and uses of renewable sources of energy in general, from agriculture and rural areas. We confirm that the opinions by the respondents vary by the type of professional education with specific and interdisciplinary knowledge on the energy sector. The similar holds for the opinions of the respondents on the promotion of renewable sources of energy from rural areas, where important are policies and support measures towards promotion of production and use of renewable sources of energy from rural areas.

For the competitive supply and efficient use of energy we find three common factors on the sustainable development in the efficient energy use (ecology, efficient energy use, R&D, knowledge, alternative sources of energy, and $CO_2$ gas emissions), price competitiveness of supply with energy (prices of energy, competitiveness and prices of electricity for households), and energy competitiveness of the economy (energy for the economy, costs and electricity in households).

For the sources of energy, renewable sources of energy, support policies and promotion of renewable source of energy are also identified three common factors on awareness, education, promotion and support for energy sources (awareness, consciousness, subsidies, promotion, food for energy, fossil cells, chemical means, biomass, intensity in agriculture, ecological conditions, geothermal energy, education and co-production of energy), natural potentials of renewable sources of energy (solar energy, hydro plants, small hydro plants, wind energy as well as energy from agriculture, food for energy, biomass, and geothermal energy), and fossil fuels and implementation of adopted obligations (feasibility of 25% of renewable sources of energy, sufficiency of 25% of renewable sources of energy, and fossil fuels). The results on 25% feasibility and sufficiency are less stable and are less likely to be implemented without a greater policy attention by 2020.

Promotion and education activities have important role in dissemination of knowledge on more efficient energy use and on a greater supply and use of energy from the renewable sources of energy, including from agriculture and rural areas. More efficient energy use between different users and the significance of production of renewable sources of energy from different sources in agriculture have implications for rationalization of energy supply management from agriculture and for more underlined environmental protection.

The survey results imply the need for policy changes and new green energy supply management strategies that consider potentials for both more efficient use of energy and a greater production and use of energy from renewable sources of energy from hydro, solar, wind, biomass, biogas, and other renewable sources of energy. In a light of the objective to achieve 20 per cent share of production of electrical energy from the renewable sources of energy by 2020 an important role has also an improvement in information and promotion activity, and thus an improvement in knowledge, understanding and in public opinion for promotion of more efficient energy use and an improvement in the use of the renewable sources of energy in the sustainable development in Slovenia. During the last years, with policy shifts, in Slovenia is an increase in biogas and solar electricity plants on agricultural households for production of electrical and other energy and for heating. The most significant developments are some biogas equipments for electricity and energy production and for heating at large-scale pig and some other farms, and solar electricity plants on the roofs of agricultural buildings. These are also challenging issues for future research on the relations between agriculture, ecology, energy, and sustainable rural development.

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