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Visitors' preferences of renewable energy options in "green" hotels

Navratil, J.[1], Picha, K.[2], Buchecker, M.[3], Martinat, S.[4, 5*], Svec, R.[6], Brezinova, M.[1], Knotek, J.[7]

[1] Faculty of Agriculture, University of South Bohemia in České Budějovice, Branišovská 1668, 307 05 České Budějovice, Czech Republic; e-mail: josefnav@gmail.com (JN), brezina@zf.jcu.cz (MB)

[2] Faculty of Economics, University of South Bohemia in České Budějovice, Studentská 13, 307 05 České Budějovice, Czech Republic; e-mail: kpicha@ef.jcu.cz

[3] Social Sciences in Landscape Research Group, Swiss Federal Research Institute WSL, Zürcherstrasse 111, CH-8903 Birmensdorf, Switzerland; e-mail: matthias.buchecker@wsl.ch

[4*] (Corresponding author) School of Geography and Planning, Cardiff University, Glamorgan Building, King Edward VII Avenue, Cardiff, CF10 3WA, United Kingdom; phone: +44 737 99 13679; email: martinats@cardiff.ac.uk

[5] Institute of Geonics, Academy of Sciences of the Czech Republic, Drobného 28, 628 00 Brno, Czech Republic

[6] College of Polytechnics Jihlava, Department of Travel and Tourism, Tolstého 16, 586 01 Jihlava, Czech Republic; e-mail: svec.roman78@gmail.com

[7] Department of Nature and Landscape Protection, Regional Authority Southmoravian Region, Žerotínovo nám. 449/3, 601 82 Brno, Czech Republic; e-mail: jervele@post.cz

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Abstract

Tourism belongs to the industries with significant energy consumption. Visitors as well as hotel managers have, however, a positive attitude towards the responsible use of energy resources. The level of research on visitors' preferences of using different types of renewable energy is low, unlike findings on factual characteristics of conventional and renewable energies. That is why our aim was to assess visitors' preferences of environmentally friendly energy sources in hotels. Preferences of six types of renewable energy - "green" tariff energy, solar panels on the rooftops, solar panels on the ground, heat pumps, AD, wind turbine, were measured at four tourist destinations in the Czech Republic. The positive attitude of tourists towards the selected types of energy sources was confirmed. The highest preferences were found for solar panels installed on the rooftops. A typology of preferences was revealed by cluster analysis and differences between clusters were tested for independent variables. Clusters of visitors with a high and low interest in any type of renewable energy were identified as well as a cluster of visitors with interest in all types apart from solar panels installed on the ground - the visitor's origin was found as the main differentiation factor.

Key words

Renewable energy; Preferences; Behaviour; Accommodation; Tourism; Typology

1. Introduction

Hotel units are responsible for a significant proportion of energy consumption and carbon dioxide emissions in the tourism sector [1]. The guarantee of a high comfort and quality of their services is leading to high energy and water consumption in the lodging sector [2]. Energy consumption in tourism is higher than elsewhere and it fluctuates depending on the region and the visitors structure [3, 4]. What’s more, hotel buildings have higher energy consumption than other types of public buildings [5]. With regards to the process of 'greening' in tourism sector, particularly in areas such as nature reserves or culture sights,

the accommodators are pushed by the visitors into adopting pro-environmental measures. Hotels and other accommodation facilities are then becoming the ideal locations for alternative energy resource use [6, 7]. The implementation of renewable energy technology into the operation of accommodation facilities is, on one hand highly sought after [8], and among the business owners accepted [9], but on the other hand there are many existing obstacles of the development [10-14].

Scholars substantially contributed towards the understanding of the basics of owners' decision making and customers' behaviour when choosing between the conventional and green accommodation [15-18]. However, in reality, there is an abundance of renewable energy sources of a variety of 'hybrid' characteristics in accommodation facilities, either combining miscellaneous sources or just a mix of renewable energy sources [19, 20]. There is also considerable evidence that the perception of renewable energy installations differs among visitor groups, particularly from studies on wind turbines [21], little less from studies on solar panels [22, 23] and biomasses studies [24]. Nevertheless, the overall view on the perception of different types of renewable energy technologies is still missing.

That is why the following subject matter was chosen for our study: assessing the differences in visitor groups' preferences for the different renewable energy types in hotels. In particular, we will try to find out which characteristics of visitors determine their attitudes towards renewable energies in hotels. It will be investigated among visitors of four tourist's attraction sites (two natural sights and two culture sights) in the Czech Republic.

2. Background and Hypotheses

2.1 Renewable energy

Renewable energy sources are energy sources that are based on natural resources (solar, wind, biomass, geothermal) and are completely or partially renewable [25]. As a result of ongoing climate change and our overall dependency on exhaustible fossil sources of energy, the usage of renewable energy seems to be a way how to overcome the existing energy-environment crisis [26]. The (environmental) contribution/ benefit of renewables whose generation is principally decentralized [27], is based on the reduction of both emissions of greenhouse gases in the atmosphere and the level of its pollution. In our paper, we are focusing on the perception of two types of renewable

energies. Those that are producing electricity (solar energy – panels on roofs, solar energy – panels on ground, wind turbines, “green” tariff energy) and those that produce heat (heat pumps and anaerobic digestion plants).

The first type of energy that we are dealing with is solar energy. For our purposes, we are distinguishing between solar panels located on roofs and solar panels located on the ground. There are undoubtedly plenty of benefits that are connected to the usage of solar energy. Energy from the sun is widespread, inexhaustible and clean, and operational costs for solar panels are extremely low due to long life technical equipment for using of solar energy. Sunshine is, however, not equally distributed during the year and the problem has to be solved how to cover energy demand when sunshine is lacking. It is obvious that the most environmentally beneficial is a location of solar panels on roofs of houses, commercial buildings or even brownfields, while their location on a ground where they might cover agricultural land is more controversial. Spacious on ground solar power plants also create problems for future re-use for agriculture, although possibilities that merge solar energy generation and agriculture exist [28].

As for energy that is generated from wind, similar arguments might be used. Wind energy is free and enormously cost-effective if suitably located [29]. Together with solar energy, the use of wind energy belongs to the fastest growing energy sources in the world. Though, even with the most modern technology, we are able to use only a part of the whole capacity of individual wind mills; the wind conditions are usually unstable and heavy storm might damage the whole construction. Furthermore, wind mills might entail noise and visual pollution depending on the socio-cultural contexts [30]. Costs for wind mill installations are considered to be higher than it is the case for solar installations, in contrast they are less space demanding and a combination with agriculture in given place is easily feasible.

Another option to support the use of renewable energy is to promote green energy tariffs. With this option, the energy supplier is matching energy selected by consumer by renewable energy that is being supplied to the grid [31]. This solution for expanding of renewable energy is available for everybody, is democratic and significantly contributes to distributed electricity generation and supports development of green economy. In contrast, costs for introduction of such scheme are high and require government regulations.

If we consider heat pumps (as systems that transform thermal energy to heat) as an option for generation of renewable energy, it has to be taken into account that initial costs are quite high, the installation of this system is highly location-dependent and means significant disruption for the subsurface of the location [32]. Contrariwise, beneficial is usually the long lifespan of the system and

that it might be used for heating in winter and for cooling during summer. Additional electricity is always required to run the system, which means that the system is only carbon neutral if other renewable energy sources are available.

Anaerobic digestion (AD) plants are facilities that transform various types of biomass (like household bio-waste, agricultural waste etc.) into electricity and heat. Individual AD plants are highly dependent on availability and fluent supply of biomass, which significantly restricts the potential location of the site and thus the profitability of their operation. Initial costs for building of AD plant are enormously high and the location of AD has to be selected carefully as it might affect the quality of life of the local population (odour pollution, increased traffic). Otherwise, AD plants might significantly contribute to social development of their neighbourhoods as it might supply its population with heat (as co-product of digestion process).

2.2 Legal framework of renewable energies policy in the Czech Republic

The legal framework for the development of renewable energy sources in the Czech Republic consists of the three key acts [33]. The most important for the development of renewable sources use is Act no. 180/2005 Coll. on the promotion of electricity production from renewable energy sources - the targets of 8% share of electricity from renewable sources was achieved especially due to the photovoltaic energy boom. This act was replaced in 2013 by Act 165/2012 Coll. on promoted energy sources. One of its fundamental targets is a share of energy from renewable sources to amount to 13.5% of gross energy consumption in the Czech Republic by 2020. The National Action Plan for Renewable Sources of Energy further quantifies the installed capacities of individual types of renewable sources to be achieved in each year in the period between 2010 and 2020. When this annual target has been achieved, there is no legal duty to further support the installation and operation of new renewable sources by means of the feed-in tariffs or green bonuses. The State Concept of Energy 2014 [34] states that the potential of renewable energies is “limited” and main resources of renewable energies in the Czech Republic are: energy of water, wind, sunlight, biomass, biogas, energy of the surrounding environment, geothermal energy, and energy of liquid biofuels. In the State Concept of Energy, the main emphasis is put on biomass. A further issue is the effectivity of energy management defined in Act no. 406/2000 Coll.

None of the “energy“ strategic and legal documents mention any tourism related issued. The National Tourism Policy of the Czech Republic 2014-2020 (the main tourism strategic document in the Czech Republic) [35] does not address the use of renewable energy in tourism sector (the some holds for previous National Tourism Policies). However, this policy document cites the “lack of a

greater degree of application of instruments for sustainable tourism“ as weakness of the development of tourism in the Czech Republic, and the “neglect of the importance of evaluating the impact of tourism on the environment and lack of implementation of the sustainable development concept“ as threat to the development of tourism in the Czech Republic. Although the state institutions are aware of this, there is no tourism specific subsidy for renewable energies in tourism sector in the Czech Republic so far [36]. Accordingly, the use of the renewable sources of energy in tourism sector in the Czech Republic is not developed [37], similar to Slovakia [38] – e.g. there is only five hotels possessing the EU ECOLABEL (“Ecoflower”) in the Czech Republic. The certified hotels are predominantly expensive ones, which are oriented to the well-situated foreign clients and mainly located in Prague (four of those five).

2.3 Renewable energies in “green” hotels

There are many ways to make the accommodation sector more environmentally friendly. Apart from resource management and waste disposal, there are energy saving options [39, 40] such as increasing energy efficiency as well as using alternative, sustainable, environmentally friendly renewable sources of energy. The subject matter of our study focuses on the use of renewable energies.

There are several options for using the renewable energy available in the accommodation sector. The most popular ones are solar-based renewable energy-related technologies [19, 41] - especially photovoltaic power [42] and even more, the water heating solar systems [1, 20, 43].

Currently installed technologies often combine photovoltaic power with solar water heating [43] however, our research question addresses solar-based renewable energy in general. In this context, an often raised issue is the location of solar panels and also the land use if the solar panels occupy the excessive surface area [44, 45]. It seems that the perception of solar panels on the building rooftops is different from the ground-mounted ones. So, the first two renewable energies considered are **solar energy – panels on roofs** and **solar energy – panels on the ground**.

Energy harvested by wind power follows in second place [12, 46]. In some cases, this technology is recommended as more advantageous than solar-based produced renewable energy [47]. Moreover, the wind turbine generators are labelled as the 'greenest' way of generating electricity in tourist coastal sights, even in case of moderate wind speeds [48]. The third type of renewable energy included is **wind turbines**.

Another commonly used renewable energy technology in the accommodation are **heat pumps** [49-51]. So they were included into our study, too.

Shi and colleagues [52] pointed out that, the value of using waste biomasses for energy production in tourist attraction sites is still poorly understood. Thus, our study addressed **anaerobic digestion (AD)** as another issue related to tourism and renewable energy resources in hotels [20]. Anaerobic digestion varies depending on biomass sources [53], and its importance also lies in the waste management. AD can support biomass clearing on shores [54] as well as waste management in hotels and their restaurants [55-58].

In coastal areas, the tidal wave power is also considered [59], however, it is not suitable for singular accommodation facility and only makes sense if the whole resort would use it [60]. Therefore we decided not to include it in the study.

Other relevant form of energy supply for "green" hotels is the so-called **"green" tariff energy**. It means that some or all of the electricity, which is bought, is 'matched' by purchases of renewable energy. The hotel then uses the electricity from the power grid generated from renewable resources. It is apparent that this form does not contribute to hotel management options for reducing energy costs so that tourists might not be attracted by that particular technology. Moreover, the educational effect of this renewable energy supply is lacking.

Summing up, our research will focus on six types of renewable energy installations:

- solar energy – panels on rooftops,
- solar energy – panels on the ground,
- wind turbines,
- heat pumps,
- anaerobic digestion,
- "green" tariff energy.

2.4 Preferences for renewable energies in "green" hotels

The importance of the types of renewable energies used in "green" hotels is growing in specific context such as islands [12], wilderness [61] or other remote locations [59, 62]. From previous studies, it is rather apparent, that renewable energy is preferred as compared to using common resources like gas or coal [63] or nuclear power supply [64].

The first hypothesis (**H1**) we therefore propose is: all types of renewable energies are perceived as positive.

A further main question addresses the level of preference for each type of renewable energy. Each type of harvesting renewable energy sources varies in physical characteristics [20, 65]. While the general image of renewable energies has been found to be positive [66], the presence of respective installations is often perceived rather negatively [67]. This divergence of attitudes has been repeatedly determined for wind turbines [65, 68]. In some contrast to that, energy tourism is considered as emerging tourism niche [69]. The notions associated with renewable energies are diverse [70] and complex as concluded by Broekel and Alfken [68].

The second hypothesis (**H2**) we propose is: the level of preferences of each type of renewable energy differs significantly from one another.

The **third hypothesis** (**H3**) that directly follows is: there are interconnections between preferences of different types of renewable energies.

2.5 Factors influencing preferences for renewable energies in "green" hotels

Recent research has shown that there are many factors influencing visitors' decisions to stay in a "green" hotel [71]. In this context, however, little attention has so far been directed to visitors' perceptions of the various renewable energy types. We assume that the factors affecting the decision between "conventional" and "green" hotel will be similar. These factors can be grouped into several categories, in particular, socio-demographic factors and factors affecting behaviour as defined in the theories of planned behaviour [72]. Socio-demographic factors selected for this study are the ones that were found to be most important in the decision processes of tourists [73]. They are also that ones, that appeared to be important for the decision to stay in a "green" hotel [3, 74, 75].

Firstly, acknowledged variables having an influence on choosing "green" hotel are **gender** and **age**. This relates to the findings that environmentally conscious behaviours, attitudes, perceptions or intentions in tourism are stronger in females than in males [74], and that age is has been found to be responsible for differences in pro-environmental inclination in tourism. Compared to gender, the age influence is less consistent, and in most cases, it has not been confirmed [74, 76].

Socio-economic criteria have also been found to affect „green" behaviour, which is generally associated with a higher cost during the holiday [77]. In particular, people with higher pro-

environmental attitudes are usually more **willing to spend more on „green“ holiday** [75]. The **origin of the visitor** significantly affects his/her general behaviour [78] and also the behaviour towards environmentally friendly travelling [3, 79].

The **fourth hypothesis (H4)** we further propose is: socio-demographic characteristics of visitors influences the structure of preferences for renewable energies in “green” hotels. Gender (**H4.1**), age (**H4.2**), travelling expenses (**H4.3**), and visitors’ origin (domestic/foreign tourists) (**H4.4**) as potential socio-demographic characteristics of visitors influence the structure of preferences for renewable energies in “green” hotels will be tested.

Secondly, the preference for renewable energy installation in hotels was expected to be associated with the behaviour at the destination and particularly the decision on what type of “green” hotel to visit. There are several contributions summarised by Gao and colleagues [15], stating, based on 185 unique observations, that attitudes, values, awareness and perceived benefits are linked to “green” hotel selection. Most of these studies are based on Ajzen’s theory of planned behaviour [80] that considers **attitudes towards the behaviour**, **personal norms** and **behaviour control** as the main concepts affecting behaviour, together they are expected to influence intended behaviour as a mediator of **real behaviour**.

The **fifth hypothesis (H5)** we further propose is: factors of behaviour influence the structure of preferences for renewable energies in “green” hotels. Attitudes (**H5.1**), behaviour control (**H5.2**), personal norm (**H5.3**) and real behaviour (= “green” hotel choice) (**H5.4**) will be tested.

Finally, previous studies also show that visitors in **different locations** vary strongly in their pro-environmental behaviour [81]. The places they visit at their holiday destination are good indicators of their pro-environmental preferences [82].

We can thus propose our **sixth hypothesis (H6)**: the structure of preferences varies by dominant characteristics of the visited location.

3. Methods

To test the hypotheses, necessary data were collected among visitors of four tourist sites using a standardised survey.

3.1 Data collection

All data were gathered by a standardised survey. To ensure the validity of the questionnaire items, a comprehension pre-test was carried involving a sample of 20 volunteers during May 2015. The revised versions of the questionnaires were handed out and collected in the period of June and October (= main tourism season) 2015.

As it was intended to test the potential differences between visitors of distinct types of sights **(H6)**, two different types of visitors' destinations were selected – destinations focused on cultural heritage and destinations focused on natural heritage. Two tourist sites were selected from each of both types of sights in the Czech Republic – two sights of cultural heritage (UNESCO Cultural heritage sight Český Krumlov – chateaux visitors; National cultural monument Kratochvíle chateaux - chateaux visitors) and two sights of natural heritage (UNESCO Biosphere reserve Pálava – visitors at vantage point Děvín; Žďárské vrchy PLA - visitors at vantage point Devět skal).

To assure a random sample, every tenth visitor was approached during week-days and weekends. Overall, 200 respondents were addressed at each site. The refusal rate was 28.38 % on average and varied from 48.50 % in Český Krumlov to 10.00 % in Kratochvíle chateaux. Altogether, 573 respondents above the age of 18 participated in the survey (Table 1).

Table 1. Respondents of the survey.

n		573
gender	female	48.0%
	male	52.0%
age (mean)		42.1 years
money/night/person (mean)		1,045 CZK
foreign (yes)		26.9%
nights spend in "green" hotel		16.8%

3.2 Questionnaire

The questionnaire consisted of an introduction and three main parts. In the introduction, the issue of "renewable energy" was explained to the respondents. We thereby used the definition from Ellabban and colleagues [83]: "Renewable energies are energy sources that are continually replenished by nature and derived directly from the sun (such as thermal, photo-chemical, and photo-electric),

indirectly from the sun (such as wind, hydropower, and photosynthetic energy stored in biomass), or from other natural movements and mechanisms of the environment (such as geothermal and tidal energy). Renewable energy technologies turn these natural energy sources into usable forms of energy – electricity, heat and fuels."

The first main part was dedicated to data related to visitors' perception of different renewable energies (dependent variables to test all hypotheses). The second part included items measuring the factors of pro-environmental behaviour (to obtain data for testing H5). In the third part, questions addressing socio-demographic factors were placed (to obtain data for testing H4).

Visitors' **preferences (H1, H2, H3)** for six environmental-friendly installations providing renewable energy resources for hotels were measured by the following question: "If other parameters remained but the price of accommodation increases by 25 %, I would prefer a hotel that has . . . " Six renewable energies were stated as a choice: solar energy – panels on roofs; solar energy – panels on the ground; wind turbines; heat pumps; anaerobic digestion; "green" energy". The items were measured on 5-point Likert-like scale where 1 = definitely no; 2 = rather no; 3 = cannot decide; 4 = rather yes; 5 = definitely yes.

Visitors' **attitudes (H5.1)** towards environmental friendly tourism were measured based on their degree of involvement in the public financial support to "green" energy in hotels. The question was: "I find the public financial support to "green" energy installations in hotels as . . ." It was assessed by using a standardized scale of ten bipolar adjectives measured on a 7-point scale. The revisited Personal Involvement Inventory Scale was used as its advantage is one-dimensionality as well as the versatility of use [84]. The degree of the involvement of respondents was calculated using the mean values of the ratings of ten bipolar adjectives including "unimportant-important", "boring-interesting", "irrelevant-relevant", "unexciting-exciting", "means nothing - means a lot to me", "unappealing-appealing", "mundane-fascinating", "worthless-valuable", "uninvolving-involving", "not needed – needed".

The scale for measuring **behavioural control (H5.2)** was adopted from Han et al. [80]. Thus, three items were included: "Whether or not I stay at a green hotel when traveling is completely up to me.", "I am confident that if I want, I can stay at a green hotel when traveling.", and "I have resources, time, and opportunities to stay at a green hotel when traveling. We used a 5-point scale of measurement. The degree of behavioural control of respondents was calculated using mean values of responses in all three questions.

Personal norms (H5.3) were also measured by a scale proposed by Han et al. [80]. The same three items as in Han et al. were used: "Most people who are important to me think I should stay at a

green hotel when travelling.", "Most people who are important to me would want me to stay at a green hotel when travelling.", and "People whose opinions I value would prefer that I stay at a green hotel when travelling." Responses were measured on a 5-point scale of measurement. The degree of personal norms of respondents was calculated using the mean values of the ratings of all three items.

To measure the **real** pro-environmental **behaviour (H5.4)** within accommodation sectors, we asked the following two questions: "Please estimate the number of hotels (or guest houses or another accommodation facility) you have visited in last two years" and "How many of them were obviously pro-environmental?"

The questionnaire ended with **socio-demographic questions (H4)** including **gender (H4.1)** (nominal bivariate variable with levels female and male), **age (H4.2)** (ratio variable measured in years), average **cost per person per night stay** during the holiday in the last two years **(H4.3)** (ratio variable measured as CZK per person and night of stay), and the **origin of respondent (H4.4)** (nominal bivariate variable with the levels domestic and foreign).

3.3 Statistical Analyses

Several statistical approaches were adopted to consider all our hypotheses.

To test our first two hypotheses **(H1 and H2),** mean values gained from responses on preferences of six renewable energy installations were calculated and then tested using Repeated Measures Analysis of Variance (RMANOVA). Analysis of Variance is used to test potential differences among means of groups/variables – it is based on variances in groups and among groups. Because each respondent decided for each type of the 6 renewable energies we used the type "Repeated Measures" of this test as responses to one technology are not statistically independent from responses to other technologies. The results of RMANOVA (= the differences in the averages) were further tested by the Tukey post hoc test to find out how the preferences differ one from another.

To identify the visitors' preference pattern for six renewable energy installations at their destinations **(H3),** cluster analysis was used. Cluster analyses are applied to make groups out of objects (= respondents) or variables (= 6 renewable energy technologies) according to their similarity in values measured in each variable for each object. Our aim was to make the groups of respondents, thus objects were clustered. In making an appropriate number of clusters usually two cluster analyses are employed. First, the hierarchical cluster analysis is undertaken to obtain knowledge how the objects are similar with one another. We used the Ward method of grouping and Euclidean distance as the measure of "similarity" of respondents. The decision how many clusters are appropriate is always

difficult and is dependent on the “nature” of the data, the aim of cluster analysis, and “optimal” ratio between number of clusters and variance lost by grouping to make the result as simple as possible [85]. The decision is usually based on dendrogram and amalgamation schedule, where we try to find main “breaks” in similarity (measured as distance). In our case the optimal number of groups in our data was five. It is good when the optimal number of clusters means not a drastic loss of information of data directly measured - for our data and five clusters the loss of information was small (about 20%), thus considered as appropriate. The types of visitors’ preference pattern were subsequently identified in a second step by using the K-means clustering with the number of clusters identified by the hierarchical cluster analysis (i.e. 5). K-means clustering classify each object into a given number of clusters. The meaningfulness of those classification was tested further based on other variables.

In a further step, we proceeded the testing of all other hypotheses. We decided to use two approaches. Firstly, all variables were tested separately. The differences in all factors of behaviour **(H5)** including attitudes, norms , control, and stay in “green” hotel , and also age **(H4.2)** and money spent /night/person **(H4.3)** as ratio variables between the five types of tourist (based on H3) were tested by a series of One-way Analysis of Variance (ANOVA) with the Tukey post hoc test for unequal number of n (unlike in the case of testing the hypotheses H1 and H2, the samples here are independent one from the another and the number of respondents are different among groups, so special post-hoc test had to be used). Gender **(H4.1)**, location **(H6)** and origin **(H4.4)** were tested by means of chi-square tests, as those variables were nominal (all bivariate – the numbers of respondents in combination of category levels were tested against its evenness). The Non-parametric regression (generalized linear model) was used as the second approach; a common way to identify statistically important independent variables, as it was used in similar studies [86, 87]. Regressions are employed to find out which of a number of predictors are important for variance in dependent variable. The dependent variable here is nominal and it is the type of respondent (= the result of cluster analysis), predictors are all other variables tested separately in previous analyses (ANOVAs and chi-square tests). Our aim was to find (1) which of the studied factors are responsible for visitors’ preference pattern for competing renewable energy installations, and (2) which variables are dominant in the sub-sample of respondents of the first (= most interested) preference type group and not in the sub-sample of any other group. Statistical importance of independent variables was tested by type III likelihood test and Wald test. The distribution of the dependent variables is multinomial.

4. Results

4.1 Visitors' preferences for renewable energy installations in "green" hotels

The data analysis (RMANOVA) revealed that all renewable energy installations were in average assessed as positive except for the solar panels on the ground, the 95 % interval of the reliability of which extends below the neutral value of 3 (Figure 1). The highest statistical average was reached by solar panels on the rooftops.

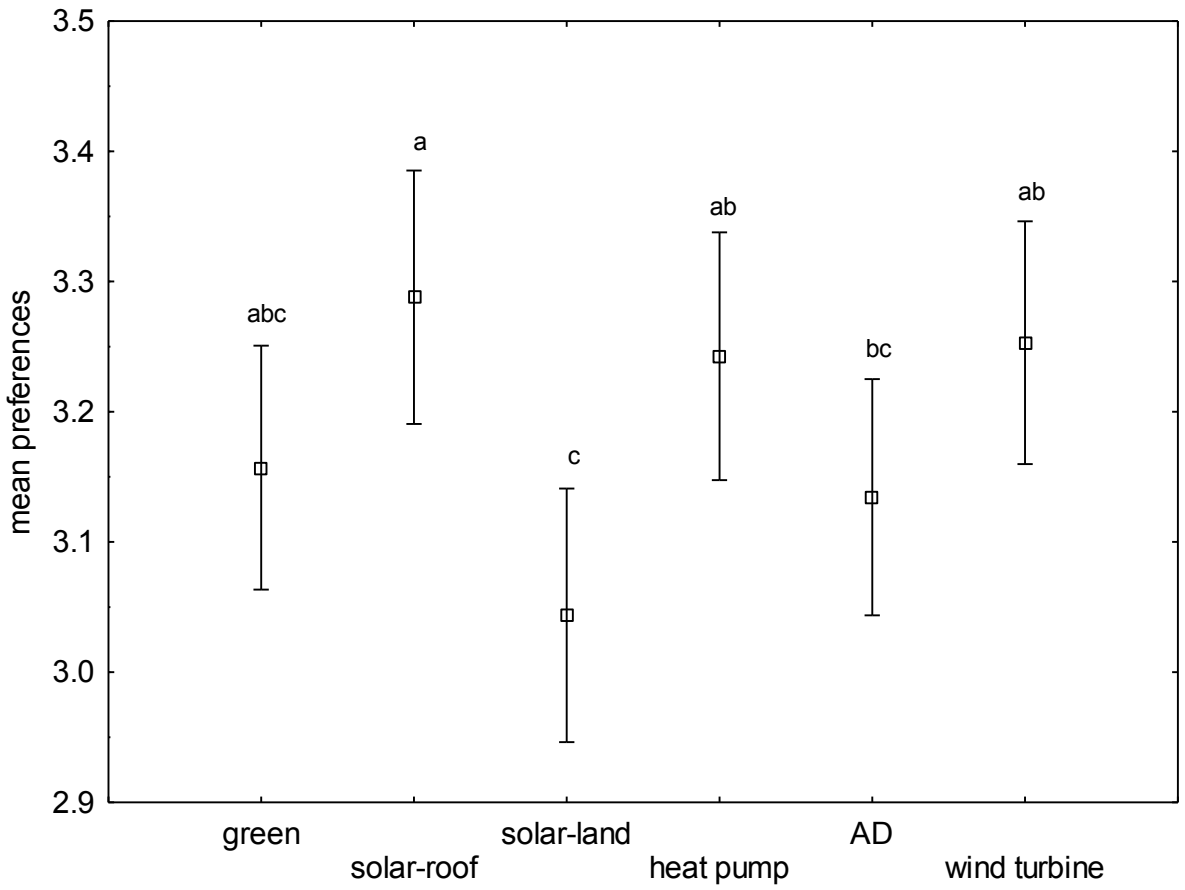

Figure 1. Mean values (squares) with the 95% confidence intervals (whiskers) of preferences for the six studied types of renewable energy installations. Mean values labelled with the same letter do not differ significantly one from another (they represent the homogenous groups as result Tukey post-hoc comparison test, $p > 0.05$). Short-cuts of the installations: green = "green" tariff energy; solar-roof = solar energy – panels on rooftops; solar-land = solar energy – panels on ground; AD = anaerobic digestion.

The hierarchical cluster analysis with scree plot revealed five clusters (Figure 2), which were defined by K-means clustering and finally numbered by decreasing values of total average of preferences (cluster 1 = cluster with the highest total average of preference for renewable energy installations and cluster 5 = cluster with the lowest total average preference for renewable energy installations). Cluster 1 and 5 were those with a simple preference pattern. Cluster 1 includes a pool of respondents who had shown a high preference for all the researched types of renewable energy installations, whereas cluster 5 consists of respondents with low preference in any of them. Cluster 2, in turn, consists of respondents who expressed preference above average for all installations except for solar panels on the ground. Clusters 3 and 4 include both respondents with average interest in some renewable energy installations. They, however, differ from one another in their preference for specific renewable energy installation types. While in cluster 3, there is a preference above average for "green" tariff energy and solar panels, respondents of cluster 4 show for these options a distinctly low preference and a preference above average for AD and wind turbines.

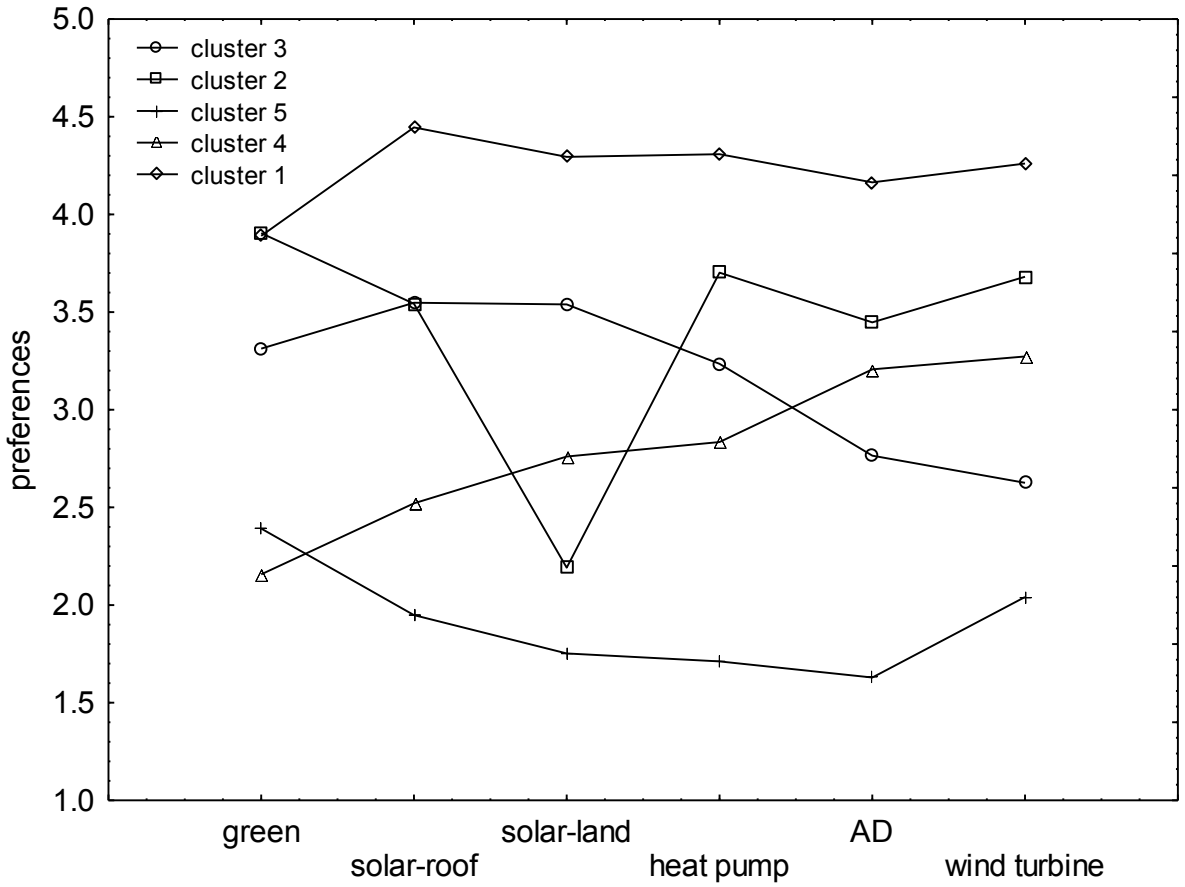

Figure 2. Mean values of preferences for one of the six renewable energy installation types in five clusters of respondents.

The differences among the 5 groups of respondents for attitudes, norms, control, stay in “green” hotel, age, and money/night spending were tested by separate ANOVAs. For four out of those independent variables, the differences were confirmed in post-hoc tests (Table 2). For attitude and norms, the average values fall with the number of each cluster, and so does the preference for renewable energy installation types. Statistical differences are found in clusters 1 and 2 compared to cluster 5, and in the case of norm also compared to cluster 4. For behaviour control, the lowest values were found in clusters 3 and 4 having a statistical difference compared to clusters 1 and 2. In the case of “green” hotels visited in the last two years, the values fall again with the cluster number, however, there is a statistical difference found only between clusters 1 and 2 (high preference) and cluster 5 (lowest preference). The average age grows continuously with the number of clusters while statistical differences were not found.

Table 2. Results of One-way ANOVAs – means and standard deviations (S.D.) are shown for all five clusters and all interval variables. Mean values labelled with the same letter do not differ significantly one from another (they represent the homogenous groups as result of Tukey post-hoc comparison test, $p > 0.05$). F statistic with significance levels of each ANOVA is shown in last column, * denotes $p < 0.05$, ** denotes $p < 0.01$, *** $p < 0.001$.

	cluster 1 mean ± S.D.				cluster 2 mean ± S.D.				cluster 3 mean ± S.D.			
attitudes	4.92	±	1.14	a	4.61	±	1.29	a	4.13	±	1.29	b
norms	3.31	±	1.02	a	3.13	±	1.10	ab	2.84	±	0.86	bc
control	3.87	±	0.87	a	3.71	±	0.82	ab	3.27	±	0.90	c
“green” hotel	21.05	±	29.47	a	20.95	±	27.24	a	17.19	±	22.59	ab
age	39.08	±	13.86	a	41.15	±	16.31	a	42.78	±	15.89	a
money/night	946.03	±	536.17	a	1,183.15	±	787.79	a	1,110.65	±	946.72	a

	cluster 4 mean ± S.D.				cluster 5 mean ± S.D.				F
attitudes	3.62	±	1.20	bc	3.42	±	1.33	c	30.86***
norms	2.70	±	0.73	c	2.19	±	0.97	d	23.44***
control	3.29	±	0.78	c	3.41	±	1.03	bc	11.87***
”green” hotel	14.79	±	20.14	ab	10.76	±	17.29	b	3.53**
age	43.34	±	17.44	a	44.97	±	16.98	a	2.39*
money/night	1,006.18	±	678.39	a	1,032.99	±	768.67	a	1.77

For three bivariate independent variables, statistical differences between their distributions in the clusters were confirmed by chi-square tests (Table 3). The highest difference was noted for the origins of the respondents. Foreign visitors’ presence in cluster 1 is almost 1.75 times higher as compared to the statistically expected values, whereas its presence in cluster 3 reached only half of the statistically expected number and not much more in clusters 2 and 4. The presence of foreign

visitors in cluster 5 is in the region of expectation. For gender as well as sight type of destination, the statistical differences of presence in the clusters are lower though still conclusive. The presence of females in cluster 4 is significantly lower than in other clusters. As for respondents' presence in historical sites, there is a significantly smaller number in cluster 1 as compared to the clusters 4 and 5.

Table 3. Results of chi-square tests. The numbers in tables are ratios between observed and expected values.

	females	historical	foreigner
cluster 1	1.04	0.80	1.73
cluster 2	1.17	1.01	0.71
cluster 3	1.11	0.97	0.52
cluster 4	0.72	1.10	0.71
cluster 5	0.99	1.19	1.11
Chi-square	12.63	10.28	44.78
d.f.	4	4	4
p	0.013	0.036	< 0.001

We have undertaken the non-parametric regression analysis after all previous analyses were done. Five of the nine independent variables included were found to be statistically significant for explaining the variability in respondent's inclusion in each cluster. The strongest predictors appeared to be the three behavioural factors (attitudes, personal norms, behavioural control) but also age and origin (domestic/foreign) were adopted as significant parameters. For all five variables, the conclusive high values of Wald statistics were reached in the model and it was also confirmed by chi-square test values using same variables in type III likelihood ratio test (Table 4). The Chi-square - d.f. ratio is very close to 1 (1.07 exactly), thus we can conclude that there is no evidence of overdispersion. Those variables then have a statistically significant influence on respondents' presence in clusters of preferences for each type of renewable energy installation.

Table 4. Results of non-parametric regression model.

	Type III Likelihood test				test of all effects		
	d.f.	Log-Likelihd	Chi-Square	p	d.f.	Wald Stat.	p

Intercept					4	38.187	0.000
attitude	4	-821.485	40.436	0.000	4	36.825	0.000
norms	4	-817.911	33.290	0.000	4	29.971	0.000
control	4	-808.173	13.812	0.008	4	13.477	0.009
“green” hotel	4	-801.946	1.359	0.851	4	1.281	0.865
age	4	-804.044	5.555	0.235	4	5.422	0.247
money/night	4	-803.133	3.732	0.443	4	3.603	0.462
gender (female)	4	-806.523	10.512	0.033	4	10.233	0.037
place (cultural)	4	-801.950	1.367	0.850	4	1.366	0.850
foreigner (yes)	4	-816.510	30.486	0.000	4	29.002	0.000

In a final step, the effect of those independent variables on the difference in respondents’ presence, in cluster 1 or in any other, was assessed. Parameters’ estimates, their standard errors, and statistical significance are summarized in table 5. Cluster 1 was used as the reference category for the comparisons with all the other categories. Respondents in cluster 5 are compared to respondents in cluster 1 of higher age and have much more negative attitudes and norms towards staying in “green” hotel. The effect of attitude also differs significantly between cluster 1 and 4 respectively 3. These clusters are also characterized by lower behaviour control and markedly lower presence of the foreign visitors. The presence of domestic visitors explains the presence of respondent in cluster 2.

Table 5. Testing of regression estimates for reference category (= cluster 1).

Effect	Dependent	Estimate	S.E. of Estimate	Wald statistics	p
Intercept cluster 5	cluster 5	4.507	0.949	22.560	0.000002
attitude	cluster 5	-0.667	0.135	24.461	0.000001
norms	cluster 5	-0.875	0.170	26.464	0.000000
control	cluster 5	-0.216	0.180	1.445	0.229291
“green” hotel	cluster 5	-0.008	0.008	1.030	0.310228
age	cluster 5	0.021	0.009	4.945	0.026162
money/night	cluster 5	0.000	0.000	0.908	0.340535
gender (female)	cluster 5	0.002	0.150	0.000	0.986707
place (cultural)	cluster 5	0.135	0.157	0.737	0.390553

foreign (yes)	cluster 5	-0.223	0.162	1.891	0.169139
Intercept cluster 4	cluster 4	3.838	0.882	18.947	0.000013
attitude	cluster 4	-0.627	0.127	24.363	0.000001
norms	cluster 4	-0.270	0.152	3.150	0.075909
control	cluster 4	-0.405	0.168	5.793	0.016093
“green” hotel	cluster 4	0.000	0.006	0.003	0.955910
age	cluster 4	0.016	0.009	3.100	0.078309
money/night	cluster 4	0.000	0.000	0.142	0.706454
gender (female)	cluster 4	-0.258	0.139	3.437	0.063733
place (cultural)	cluster 4	0.072	0.144	0.250	0.616827
foreign (yes)	cluster 4	-0.484	0.156	9.630	0.001914
Intercept cluster 3	cluster 3	2.519	0.868	8.419	0.003714
attitude	cluster 3	-0.312	0.125	6.218	0.012644
norms	cluster 3	-0.196	0.151	1.685	0.194309
control	cluster 3	-0.528	0.167	9.994	0.001571
“green” hotel	cluster 3	0.000	0.006	0.000	0.984734
age	cluster 3	0.015	0.009	2.739	0.097911
money/night	cluster 3	0.000	0.000	1.489	0.222420
gender (female)	cluster 3	0.108	0.136	0.638	0.424394
place (cultural)	cluster 3	0.062	0.140	0.195	0.659059
foreign (yes)	cluster 3	-0.732	0.167	19.303	0.000011
Intercept cluster 2	cluster 2	-0.298	0.912	0.107	0.743946
attitude	cluster 2	-0.147	0.128	1.307	0.252960
norms	cluster 2	-0.040	0.153	0.069	0.792586
control	cluster 2	-0.079	0.179	0.193	0.660210
“green” hotel	cluster 2	0.000	0.005	0.006	0.940448
age	cluster 2	0.010	0.009	1.280	0.257945
money/night	cluster 2	0.000	0.000	2.862	0.090686
gender (female)	cluster 2	0.154	0.139	1.228	0.267735
place (cultural)	cluster 2	0.148	0.142	1.079	0.298937
foreign (yes)	cluster 2	-0.613	0.160	14.667	0.000128

5. Discussion

In our study, we have investigated the factors influencing visitors’ preferences of renewable energy implementations. Based on empirical data collected in four tourism sites in Czech Republic we tested a number of hypotheses suggested by research literature. Some of the tested hypotheses were

supported, some had to be rejected. The summary of all hypotheses listed is in table 6 below and each hypothesis will be discussed individually.

Table 6. List of the hypotheses tested and their outcomes.

Hypotheses	decision
H1 – all types of renewable energies are found positive	supported
H2 – the level of preferences for each type of renewable energy differ significantly from one another	supported
H3 – there are interconnections between preferences of different types of renewable energies	supported (not directly tested)
H4.1 – structure of preferences varies by gender	supported
H4.2 – structure of preferences varies by age	not supported
H4.3 – structure of preferences varies by travelling expenses	not supported
H4.4 – structure of preferences varies by visitor's origin (domestic/foreigner)	supported
H5.1 – structure of preferences varies by attitude	supported
H5.2 – structure of preferences varies by behavioural controls	supported
H5.3 – structure of preferences varies by personal norms	supported
H5.4 – structure of preferences varies by real behaviour ("green" hotel choice)	supported
H6 – structure of preferences varies by visited location	supported

The first three hypotheses (H1-H3) assessed the issues of visitors' preferences for renewable energy implementations in "green" hotels. All three hypotheses were supported. All six types of renewable energy implementations reached above average values in preferences (**H1**) so they can be regarded as positively assessed alternatives to conventional energy use [63]. Via RMANOVA and post-hoc tests, the differences between each researched type were identified (**H2**). Significant differences could be found between solar installations on the roof and anaerobic digestion (AD), and in particular, between solar installations on the ground and the rest of the renewable energy installations considered.

These findings confirm results from other recent studies emphasizing the general public's preference for renewable energy use as compared to the use of non-renewable energies, and solar energy use as compared to the use of other renewable energy sources [88, 89]. In agreement with our findings,

the few existing studies on comparative perceptions of renewable energy implementations suggest that solar panels rank highest, but only when sited on rooftops [90] whereas wind turbines achieved a ranking in the middle range [65].

The interesting outcome from hypotheses **H1** and **H2** is the difference in the perception of solar panels installed on the rooftops, being the most accepted alternative, and solar panels installed on the ground being the least accepted option. Solar energy is generally perceived as the most relevant [91] and mostly accepted from all renewable energy types [90]. There are several reasons providing an explanation for such an opinion. Firstly, solar panels implemented on existing infrastructure such as roofs, noise protection walls or avalanche barriers are better accepted than ground-mounted solar panels (Michel et al., 2015). There are, however, also context specific explanations for this clear finding. In the Czech Republic, the image of renewable energies has generally declined dramatically as a consequence of a substantial number of scandals connected with drawing public money for the support of renewable energy development after entering the EU. Particularly, a large public controversy has risen from several cases of partially publicly funded large private on-ground solar power plants, whose owners have remained unknown. A number of speculations appeared that those are secretly owned by politicians who previously authorized the public funding (so-called “solar barons”). Secondly, on-ground solar power plants cover more than 4 thousand hectares of agricultural land as a result of misleading support policy. This issue is also heavily discussed in Czech media and it significantly affects the perception of on-ground solar power plants in the Czech Republic. Actually, solar roof panel installations are not so popular neither and the targets of the renewable energy subvention policy were not met. Thirdly, natural conditions of solar radiation in Central Europe do not meet the criteria for efficiency; however, the Czech Republic is the 3rd country in the EU having solar installations per capita. Fourthly, the location of large solar power plants in the Czech Republic is quite confusing, among the largest solar power plants are those located in the mountains in such conditions making another controversy concerning their efficiency.

More unexpectedly, the cluster analysis revealed five types of preference pattern among the visitors, which tentatively supports **H3**, although there were limited possibilities to test that. Only some indications pointed out that there are visitor groups specific preference pattern. Nevertheless, we could show that the presence of defined groups of respondents (see H4-H6) varies in these clusters, which confirms that those five groups exist and that they are not just a result of the statistical method. Thus, these groups differ in terms of behaviour factors, gender, origin and place of visit. Destinations can foster energy change depending on the specific visitor profile.

Further hypotheses (H4-H6) were dedicated to the 'type' of visitor and the structure of preferences revealed in the previous step. In one dimensional view, almost all hypotheses were supported apart from age and average expenses. First confirmed was the effect of gender (**H4.1**), particularly females having higher pro-environmental consciousness [92] also closely touching the preferences for eco travelling and eco-friendly hotels [93], although there are models showing higher preferences of males [94]. However, the intentions are not planned at first – the presence of females and males in groups with generally higher and lower preferences is indistinctable from zero model. Consequently, it differs in the significantly higher ratio of females in the group with higher preferences for solar panels and the lowest ratio in the group of high interest in AD and wind turbines. Thus, females prefer solar energy not considering it as a damaging interference into the visual landscape [95] and are more likely to feel annoyed by wind turbines' noise [96]. Males, on the other hand, support wind energy use, which is also confirmed in a recent study of Hui et al. [97]. For example, Claudy et al. [98] have not noted any differences in willingness to pay extra for photovoltaic panels, solar water heaters, and small wind turbines. Furthermore, gender was identified as an important variable also in our regression model, similarly to Rai and Beck [87], but not being the case in some other studies [86].

The age influence (**H4.2**) on preferences was not confirmed so this hypothesis was then rejected. Liang et al. [92] reported that elderly respondents are more sceptics to energy preserve programs involving solar panels and it was further explained by a willingness to take a risk. This is also the case of renewable energies adoption in Germany [86] or solar energy in the UK [95]. Tsagarakis et al. confirm that younger respondents prefer environmentally friendly hotels [93]. Cloudy et al. [98] found that willingness to pay more was not influenced by age. Adopters of photovoltaics energy use were younger in a study conducted by Vasseur and Kemp [99], however, they are of higher age in Keirstead's study [100].

There was no statistical difference found in the results of the expenses variable (**H4.3**) regarding the willingness to pay more for renewable energies in hotels. This is in contrast to some previous studies. Generally, slightly above average interest for specific "green" products was found in tourism demand as summarized by Dimara and colleagues [76]. She also found that there is a link between willingness to pay and the expenses of tourists during their visit. The difference was approved by Shuai et al. [101] and reported by Keirstead [100] but refused by Rai and Beck [87]. The latter is true also for Kostakis and Sardinau [94] who reported none economic predictable variable significant for willingness to pay more for renewable energies in hotels. The mixed results of different studies are perhaps given by mixed effects of economic variables on variables under study [94] and the type of

hotel [76]. This hypothesis has to be also rejected because the influence was not found, not even in the simple average test nor in regression.

The origin of visitors was found to be extremely important in preferences, therefore our further hypothesis (**H4.4**) is supported. It is well known that domestic visitors and foreign visitors behave in different ways within destinations [73] resulting in different impacts [102]. According to the study of Tyrvainen and colleagues [103], Eastern European tourists are willing to engage less in sustainability practice, whereas, the Atlantic Europeans are the most willing to engage in recycling and renewable energy use. It generally means that the chances are much higher in deciding for a „green" hotel by visitors form highly informed cultures about energy saving matters than visitors from countries with limited number of information [93]. In the sample presented, foreign visitors present, compared to the expected average model, the whole three-quarters of respondents in the first group with the highest preferences for all types of renewable energies. So foreign visitors will, in the CEE conditions, belong among the driving force leading the adaptation process towards the use of renewable energies.

All three predecessors of intended behaviour (attitudes, norms, control) were found to be important for the structure of preferences, thus hypotheses **H5.1-H5.3** are supported. We can conclude, that the structure of preferences to different types of renewable energy implementations used in "green" hotels is corresponding to those, which are responsible for differences between conventional and renewable energies [104]. That similar goes for real behaviour (**H5.4**), however, its information value is surprisingly lower. This result then corresponds with particular models tested by Tsagarakis et al. [93]. A bit in contrast to our findings about visitors' preferences, Rai and Beck [87] found attitudes to be little relevant for considering the implementation of renewable energies among residents from Texas.

The place of study (**H6**) has been found to influence the respondents' belonging to a particular preference group. However, the impact on the structure of preference could not be confirmed. Our results showed the lack of respondents from culture heritage sights in the first preferential group (high interest in all types of renewable energies), which corresponds to the visitors structure of each type of sights in the Czech Republic [82].

6. Conclusion

The aim of the study was to identify the preferences of selected types of renewable energy installations among domestic and foreign visitors in cultural and natural sights and furthermore, to

explain the structure of the preference pattern. The analysis of survey data gathered in for Czech tourism destinations confirmed that visitors could be grouped in different preference types found solar panels installed on the rooftops to be the renewable energy installation generally most, whereas the one least preferred were solar panels installed on the ground, which is remarkable since solar panels are generally the most accepted source of electrical energy. Interestingly, respondents' expenses during their visit were not found to be important for their willingness to pay for renewable energy installations in hotels.

Considering the structure of preferences related to renewable energy installations in "green" hotels, the analysis revealed five distinct preference types. Two of the types, visitors with particularly high and particularly low interest in renewable energy installations, appeared to be little sensitive to specific types of installations. Two preference types of visitors showed more or less average interest in renewable energies but differed in the preference of specific installations, one priorizing solar panels and the other preferring wind turbines. A fifth preference type showing a slightly higher general interest in installations appeared to be specifically sensitive to groud-mounted solar panels. Visitors belonging to preference types appeared to be significantly affected by attitudes, norms, behaviour control and real behaviour, whereas the real visit to a „green" hotel is not strongly linked to the preference type. Also, visitors' gender and the characteristics of their place of the visit were found to be significant predictors of their belonging to a preference type. These results suggest that visitors do not react homogenously to energy change in their destinations, and it is therefore necessary to use approaches to segment visitors in different preference groups.

Theoretical implications: We have found that the studied factors (gender, visitor's origin, attitudes, behavioural controls, personal beliefs, real behaviour, and visited location) have an impact on the structure of preferences for different renewable energy installations. It was found by a non-parametrical model that various combinations of factors have influenced differently the respondents' inclusion in preference groups by types. Thus, we have proven that the predictors of preferences of pro-environmental behaviour are important for differentiation of visitors according to the structure of their preferences for more different renewable energy installations. Influenced are not only preferences for sole "green" solution, choice between "green" and "conventional" energy sources but also the structure to preferences for competing "green" solutions.

Practical implications: The study confirmed that tourism participants have generally positive attitudes towards the use of renewable energy resources. The new pattern emerging from the study is that visitor groups show specific preference pattern depending not just on their attitudes, their

behaviour norms, their perceived behaviour control but also their age, gender and in particular their origin. Therefore, hotel managers have to take into consideration which target groups they have when they plan to implement renewable energy installations.

Policy implications: Adopting pro-environmental practices in Central and Eastern European Countries is difficult and overdue compared to western countries [105]. This is especially beause all pro-environmental measures are considered by managers as too expensive compared to perceived profit [106] and the cost-benefit ratio is of exteme importance here [107]. We have mentioned in the introduction that the lodging industry is one of the most important consumers of resources and polluters of environment, and if we want to make this sector clenear, we must adopt arrangements leading to this. The knowledge about renewable resources among tourists is large enough and hotels could use the "green" issues in their marketing communication with potential visitors. Thus it can be recommended to make use of renewable energies in tourism sector as a part of a strategy of tourism development and prepare instruments of support aiming at environment-friendly tourism facilities. There are many options of obtaining subsidies for pro-environmental arrangements, however there is none promoting specific subsidies for hotels and other accommodation facilities.

Limitations: Our conclusions have some important limitations, too. It was already mentioned, that the image of renewable energy sources is strongly influenced by scandals with public financing of renewable energies projects. Thus specific context of the Czech Republic could influence our results. The disproportion between factors of planned behaviour and real behaviour could be caused by the effect of high social desirability - on the other hand, this could be interesting for further study. Our results showed preferences without the NIMBY phenomenon as the distance of the installation from the hotel was not included. [108, 109].

Further study: Surprisingly, the effect of the factor of staying in a "green" hotel on visitors' preference pattern for renewable energy installations is relatively low. Essentially, the ratio of nights spent in "green" hotel was statistically different only for respondents from groups of high and low interest in all types of renewable energies. Respondents' inclusion in the cluster furthermore showed a limited connection to behaviour control, which does not correspond with natural behaviour (it should be similar). In contrast, close associations were found between visitors' belonging to clusters and their attitudes and norms. A further, more detailed, study of visitors factually staying in "green" hotels is then needed, in which the role of attitudes, norms, behaviour control and other factors on their preference pattern will be tested.

More studies are also needed to systematically test the role of economic factors for visitors' preferences of renewable energy infrastructure in hotels. Our study refused the economic factors to

be important for visitors' belonging to preference types. This finding is not very surprising as also other studies found this, but many other found willingness to pay extra for renewable energies in hotel energy to be important.

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