TURISTIČKA POTRAŽNJA I POTROŠNJA ENERGIJE U USLUŽNIM DJELATNOSTIMA: PANEL ANALIZA ODABRANIH ZEMALJA EU

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TOURISM DEMAND AND ENERGY CONSUMPTION IN THE SERVICE SECTOR: PANEL ANALYSIS OF SELECTED EU COUNTRIES

In the context of sustainable development, energy consumption reduction and energy efficiency improvement are recognized as global priorities. International tourist arrivals are increasing year by year, and tourism is recording increases in energy consumption. However, tourism needs to recognize its role in sustainable development, and make a significant contribution by using renewable energy and energy efficient technologies. Therefore, the aim of this paper is to analyze the relationship between tourist overnight stays and energy consumption in the service sector in the 10 EU countries that achieved the highest number of overnight stays. The survey covers a period of 19 years, from 2000 to 2018. Panel data analysis is used to observe the relationship between these two variables across time, based on random effects. The results show that there is a correlation between tourism overnights stays and energy consumption in the service sector, and that energy consumption is changing with the increase in tourist overnight stays. The results of the analysis indicate the need to enhance energy efficiency as well

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as encourage the use of energy from renewable sources in order to enable the sustainable development of economic and ecological systems. The empirical findings of this study can provide guidance on energy management to private entities and tourism policy makers in the EU.

Key words: *tourist overnight stays, energy consumption, energy efficiency, EU countries, panel analysis, random effects*

1. INTRODUCTION

Over the last decades, tourism has experienced continued growth, becoming one of the most important economic activities in the world. According to the World Tourism Organization Report (2019), international tourist arrivals reached 1.4 billion in 2018, an increase of 5% compared with 2017. Europe is the most visited region of the world, with a share of 51% in tourist arrivals. In 2018, Europe recorded 750 million tourist arrivals and about 3 billion tourist overnight stays. (UNWTO, 2019). However, the growth of tourist spending and the increasing number of tourists contributes not only to the economic prosperity of a country, but also to energy consumption (Gokmenoglu and Eren, 2019).

Energy issues in tourism are receiving more and more attention due to concern over the environment and sustainable development. According to Dogan et al. (2015), the tourism is directly linked to energy consumption and environmental impact. Tourist activities involve energy consumption, directly through fossil fuels or through their transformation via electricity, in every segment of tourist activity, from transport to accommodation (Dogan and Aslan, 2017). In addition, hotels are responsible for a significant proportion of energy consumption and carbon dioxide emissions in tourism (Michopoulos et al., 2017, Dogru et al., 2020, Xiangyu et al. 2021). Energy today plays a very important role in the economy of any country, and the need to increase energy efficiency is continuously pointed out, especially in the area of tourism (Krstinić Nižić and Blažević, 2017, Krstinić Nižić and Matoš, 2018, Zha et al., 2020). Energy consumption reduction and energy efficiency improvement are recognized as global priorities in the context of the green economy and sustainable development (Sineviciene et al., 2017, Dogaru, 2021).

Therefore, the main aim of the research is to analyze the link between tourist overnight stays and energy consumption in the service sector in the selected EU Member States. The 10 countries that achieved the most tourist overnight stays in 2018, namely Spain, France, Italy, Germany, Austria, the Netherlands, Greece, Croatia, Poland and Portugal, will be analyzed. The research covers a time period

of 19 years, from 2000 to 2018. The motivation for the research lies in the fact that the increase in tourism demand brings about higher energy consumption and, in that respect, tourism must become more energy sustainable, using renewable energy sources and energy efficient technologies to contribute to sustainable development.

The paper is structured in five parts. After the introduction follows the section that gives an overview of the literature and the results of previous research. The third section describes the input data, i.e., the model variables, the methodology used, and the research sample. The fourth section contains the empirical results and the discussion. The last section presents the conclusions and the limitations to the research.

2. LITERATURE REVIEW

In the last three decades, energy consumption, energy efficiency and climate change have received increasing attention from policymakers and researchers. The Agenda for Sustainable Development 2030, through its goal Sustainable energy for all, commonly known as SDG 7, emphasizes the need to improve energy efficiency and increase the use of renewable energy (United Nations [UN], 2015). The aim is to ensure access to affordable, reliable, sustainable and modern energy for all by the end of the next decade, and all these topics are fundamental to the work of the International Energy Agency (2018). Furthermore, following the Sustainable Development Agenda and the Paris Agreement on Climate Change of 2016, the European Commission adopted the European Green Deal, which aims to achieve a climate-neutral Europe through a circular economy, while increasing energy efficiency, and reducing pollution (Sikora, 2021, Eckert and Kovalevska, 2021).

The causes of tourism and energy consumption are being increasingly investigated. Dogan and Aslan (2017) conducted research on the EU member states and candidate countries. The authors analyzed the relationship between energy consumption, tourism, CO_2 emissions and real GDP. The results showed a long-term correlation between the analyzed variables. The Granger test suggested that there is one-way causality running from tourism to CO_2 emissions and two-way causality between CO_2 emissions and energy consumption, as well as between real income and CO_2 emissions. In their second study, Dogan et al. (2015) investigated the long-term dynamics of tourism, CO_2 emissions, energy consumption and real GDP for the panel of the OECD countries in the period from 1995 to 2010, using various causality methods. The results showed that the one-way causality is valid from tourism to CO_2 emissions, from economic growth to tourism, and from

tourism to energy consumption. Katircioglu et al. (2014) analyzed the relationship between tourism, CO_2 emissions, and energy consumption for Cyprus using the ARDL model. Based on the conducted research, the results indicate that international tourism has a positive and statistically significant impact on CO_2 emissions and energy consumption. Nepal et al. (2019) examined the causality relationships between tourist arrivals, economic growth, CO_2 emissions, capital formation and energy consumption. Time-series econometric methods based on cointegration tests and Granger causality tests were applied to test hypotheses relevant to the Nepalese economy. The authors concluded that adverse economic and environmental impacts could be minimized if tourism development is thoroughly well planned and controlled in line with the principles of sustainable tourism. Pablo-Romero et al. (2021) analyzed the relationships between Hotel and Restaurant electricity consumption and tourism growth in nine European countries in the period 2004–2012 through five components: energy intensity (EI), physical capital intensity (KI), physical and human capital relationship (KL), human capital intensity (LI), and the tourism factor (T). The results showed that tourist activity increases energy consumption. It also showed that better employee preparation can reduce energy consumption i.e., improve energy inefficiency. The importance of energy for the tourism sector was investigated by Krstinić Nižić et al. (2017), who argued that tourism has an impact on GDP and energy consumption. In their research, Liu et al. (2011) analyzed total energy consumption, carbon dioxide emissions, and the impacts of a variety of factors of the tourism industry (accommodation, transportation etc.) on total carbon emissions. The results showed that accommodation is the largest contributor to direct energy consumption, while transportation contributes to indirect energy consumption and carbon emission. Accommodation is responsible for 75.6% of GHG emissions in a destination (Rico et al., 2019). According to Williams and Schaefer's study (2013), managers in Eastern England have a relatively good understanding of environmental issues and climate change, and their companies have already adopted various pro-environmental measures.

Sardianou and Kostakis (2020) analyzed hoteliers' decisions for investing in renewable energy sources (RES). Results support the fact that hoteliers consider economic, institutional, and human-related factors as barriers for investing in RES. Policy-makers should consider that perceived barriers towards adopting RES differ between hotels with differing financial and energy performances. Smolčić Jurdana et al. (2020) explored the awareness of managers in tourism concerning energy saving, environmental protection, energy efficiency, climate change, and renewable energy sources in Adriatic Croatia. The results showed that managers still have insufficient knowledge concerning the impact of energy and its link to tourism. Only 30.43% of managers are well informed on matters of saving energy and more-efficient energy consumption in tourism. The authors emphasized the importance of continuous education for managers relating to energy efficiency, re-

newable energy sources, and other matters. Tang et al. (2016) measured the energy performance of 24 hotels in Lijiang, China. Data were collected on variables such as the operational and functional characteristics of the hotels. The authors concluded that hotels should be classified based on their individual characteristics and should develop energy efficiency policies according to the analyzed factors to reduce energy consumption. In a qualitative study Pace (2016) investigated the capabilities for adopting energy efficient technologies and measures in tourism accommodation establishments in Malta. The study demonstrated that managers learn how to deploy capabilities for energy innovation through creating spaces within which to learn how to identify appropriate energy solutions, evaluate technology options, and modify work practices to implement new solutions. Tsagarakis et al. (2011) explored the awareness of tourists, and proved that tourists with greater energy awareness will be willing to choose hotels that use energy-efficient appliances and renewable energy sources. Cingoski and Petrevska (2018) found that hotels may benefit from environmental pro-activeness, which is important for tourism development. The top management, however, lacks interest in the energy efficiency concept, blaming the restricted financial resources and high operation costs for limited application of renewable resources. He et al. (2020) investigated how to improve tourism energy efficiency in China. The authors concluded that the total factor productivity is a key positive driving force to boost tourism energy efficiency. The rational utilization of capital and new capital investment should accompany energy-saving technology and is essential for sustainable tourism.

From the above literature review, it is clear that tourism affects energy consumption. Following previous studies, in this paper, the relationship between tourist overnight stays and energy consumption in the service sector will be investigated, using panel data analysis.

3. DATA AND METHODOLOGY

Using the Eurostat database on tourist overnight stays in tourist accommodation establishments and countries' energy consumption in commercial and public services, this paper will analyze the relationship between these two variables for selected EU countries. Data used in this paper were obtained for 10 EU countries that achieved the most tourist overnight stays in 2018: Spain, France, Italy, Germany, Austria, the Netherlands, Greece, Croatia, Poland and Portugal. When choosing countries, the authors considered the fact that Europe is the world's most visited region. These EU tourist countries numbered 540 thousand accommodation establishments in 2018, with a total capacity of 23.6 million bed-places, 42%

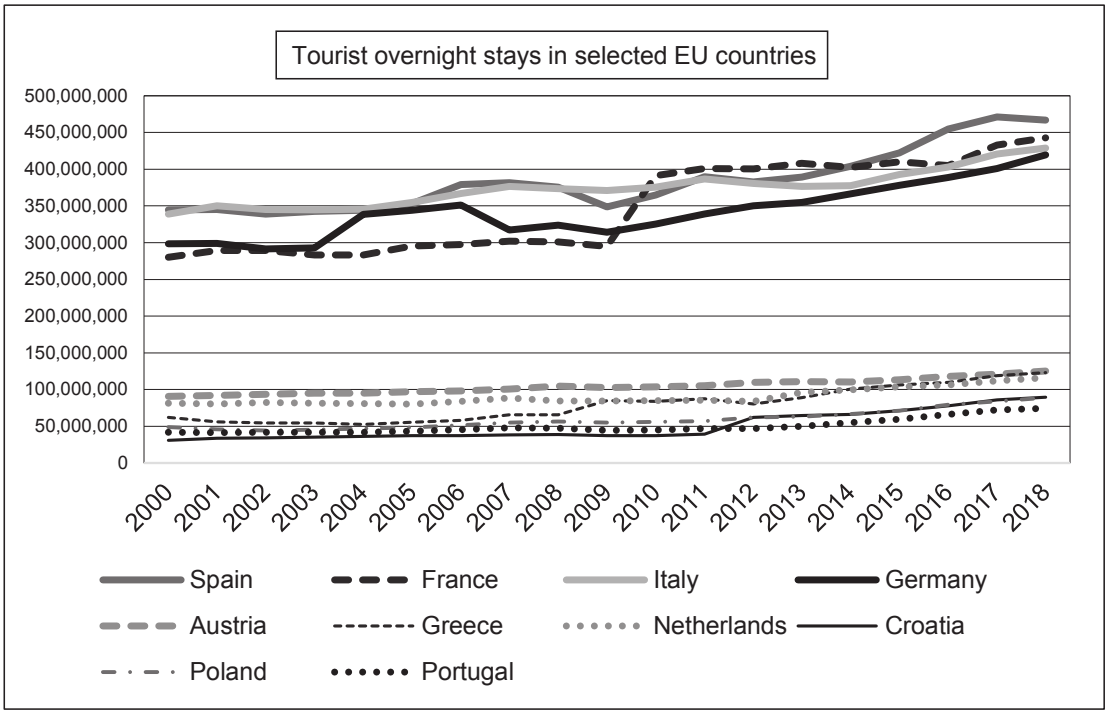
of which were in hotels. Around 700 million guests spent 2.3 billion nights in accommodation establishments (Eurostat, 2019).

The observed period is from 2000 to 2018, on a yearly basis. The variable "tourist overnight stays" includes total nights spent by residents and non-residents at all types of tourist accommodation establishments: hotels and similar accommodation, holidays and other short-stay accommodation, camping grounds, recreational vehicle parks, and trailer parks. Energy consumption in commercial and public services is the total energy consumed by end users. It includes the energy consumption of the service sector which, among others, includes the hospitality industry. Energy use in the service sector is driven by electrical heating and cooling of buildings and other structures, and through lighting, water, and sewer systems. By observing only the energy consumption of the service sector, the authors sought to exclude the energy consumption of other sectors (industry, agriculture).

Graph 1 illustrates trends in the numbers of tourist overnight stays in the selected countries.

Graph 1.

TOURIST OVERNIGHT STAYS IN SELECTED EU COUNTRIES
(2000-2018)

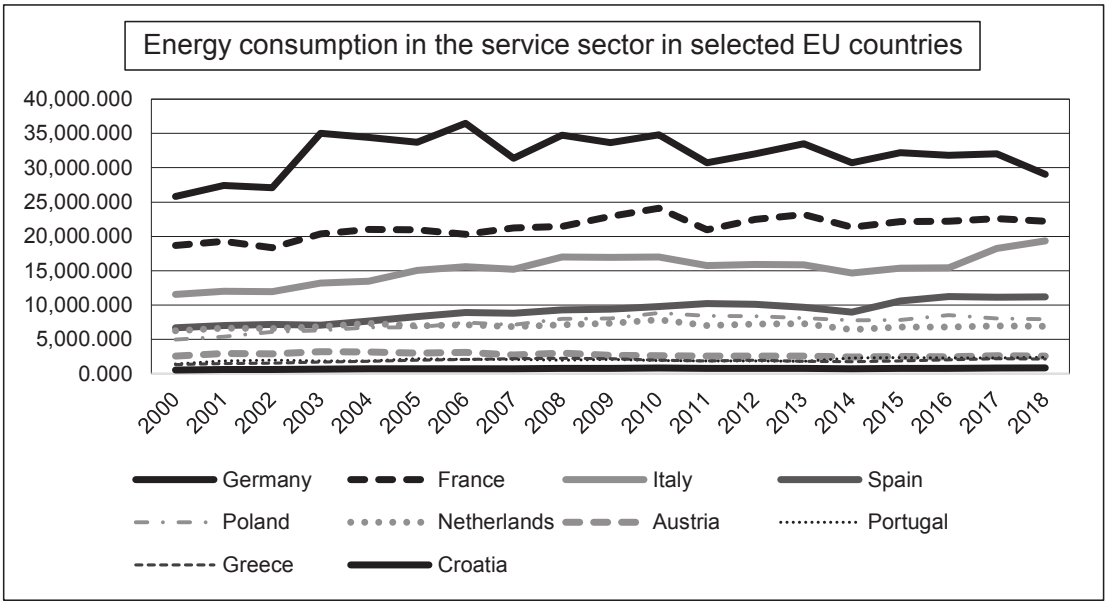


Graph 1 shows that in 2018 Spain, France, Italy, and Germany had the most tourist overnight stays, each in excess of 400 million overnights. Croatia, Poland, and Portugal had the least numbers of tourist overnight stays. With regard to the greatest increases relative to the year 2000, as the base year, Croatia shows the highest increase of 190% (30.8 million tourist overnights in 2000, compared with 89.5 million in 2018), followed by Greece with 97% and Poland with 82%. Spain recorded an increase of 35%, France 58% and Germany 40%.

The next graph illustrates energy consumption trends in the service sector.

Graph 2.

ENERGY CONSUMPTION IN THE SERVICE SECTOR IN SELECTED EU COUNTRIES (2000-2018)



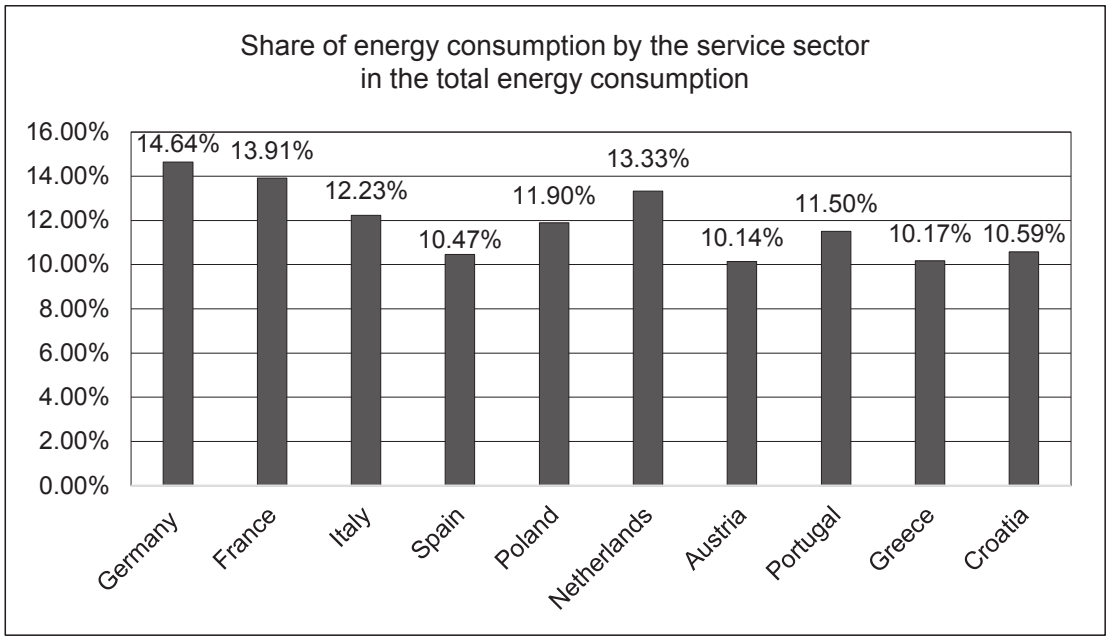
Graph 2 shows that Germany has the highest energy consumption in the service sector, followed by France, Italy, and Spain. It is interesting to note the drop in energy consumption in Germany across the years, so that its energy consumption level in 2018 is almost the same as in 2000. Italy and Spain, on the other hand, show an increase of as much as 67% relative to the year 2000, as the base year. Energy consumption in the service sector is the lowest in Portugal, Greece, and Croatia. Despite being low, the energy consumption in these countries is growing. The graph suggests that Germany is aware of the importance of reducing energy consumption and is implementing energy conservation measures and energy efficiency measures.

With regard to total energy consumption, Germany had the highest consumption in the observed years, followed by France and Italy. An analysis of total energy consumption by sector in all EU member states shows the dominance of three sectors: transport (30.8%), households (27.2%), and industry (24.6%) (Eurostat report, 2019). The service sector accounted for 14.5% of total energy consumption. In the 10 selected countries, the service sectors' share of energy consumption in total energy consumption was on average between 10% and 15%. The analysis also revealed that energy consumption decreased on average in the three dominating sectors during the observed period but increased in the service sector. Hence, it is important to establish whether there is a correlation between the number of tourist overnights and energy consumption in the service sector, in order to encourage energy efficiency and the use of renewable energy sources.

The following graph presents the share of energy consumption by service sector in the total energy consumption of the 10 selected EU countries.

Graph 3.

SHARE OF ENERGY CONSUMPTION BY SERVICE SECTOR IN THE TOTAL ENERGY CONSUMPTION OF THE 10 SELECTED EU COUNTRIES (2000-2018)



Graph 3 shows that Germany has the highest share (14.64%), followed by France (13.91%). Although Germany has the highest share on average, a look at each individual year reveals that the share of energy consumption by the German service sector in total energy consumption is decreasing. In 2009, the share amounted to 16.17% but dropped to 13.48% in 2018 (author's research based on Eurostat database). Although France has an average share of 13.91%, over the years the share has been growing (in 2018, it amounted to 15.11%).

Further, panel data analysis is used to observe the relationship between these two variables across time, based on random effects. The rationale behind the random effects model is that, unlike the fixed effects model, the variation across entities (countries) is assumed to be random and uncorrelated with the predictor or independent variables included in the model.

The equation for the random effects model is:

$$Y_{it} = \alpha + \beta X_{it} + \nu_{it} + \varepsilon_{it}$$

Where:

- Y_{it}- dependent variable where i=entity and t=time
- α- intercept
- βX_{it}- coefficient and independent variable
- ν_{it}- between-entity error
- ε_{it} - within-entity error

Random effects assume that the entity's error term is not correlated with the predictors which allows for time-invariant variables to play a role as explanatory variables. An advantage of random effects is that it can include time invariant variables. In the fixed effects model these variables are absorbed by the intercept.

4. RESULTS AND DISCUSSION

Using the Pearson coefficient, Table 1 shows the correlation between tourist overnight stays and energy consumption in the service sector in the selected EU countries.

Table 1.

CORRELATION OF THE VARIABLES IN EU COUNTRIES

Country	coefficient	p
10 EU countries	0.7541	0.0000

Source: author's calculations

In the above table we can notice a strong positive correlation between the observed variables in selected countries at the significance level $p<0.05$.

The descriptive statistics for panel data are presented in the following table. The data presented in the table describes the energy consumption in the service sector (energy_con) expressed in tons of oil equivalent (TOE) and tourist overnight stays/1000 (t_nights).

Table 2.

DESCRIPTIVE STATISTICS

Variable		Mean	Std. Dev.	Min	Max	Observations
energ_~n	overall	9976.23	9.792.254	492.319	36518.81	N = 190
	between		10191.89	6.997.049	31965.49	n = 10
	within		1.380.726	3.830.395	14529.55	T = 19
t_nights	overall	188201.6	146655.7	30857.69	471199.7	N = 190
	between		151028.1	50119.87	384210.1	n = 10
	within		29508.18	120448.2	283083.7	T = 19

Source: author's calculations

The total number of observations is 190. The panel data are balanced because all countries have data for all years. Average energy consumption in the mentioned countries in the period between 2000 and 2018 was 9976 TOE, and tourist over-

night stays were over 188 million. The lowest energy consumption was just over 492 TOE, and the largest, as high as 36518 TOE.

In order to find which model is appropriate for further analysis, the Hausman test was used. The null hypothesis is that the preferred model is random effects vs. the alternative, the fixed effects (Greene, 2008).

The results of the Hausman test are shown in Table 3.

Table 3.

RESULTS OF HAUSMAN TEST

	Coefficients (b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
t_nights	.0234327	.0244735	-.0010409	.0004872

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(1) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 4.57
Prob>chi2 = 0.0326

Source: author's calculations

The Hausman test accepts the null hypothesis, which means that the random effects model is preferred and will be used in the panel.

Before presenting the final model, regression assumptions for panel data were tested. First, a modified Wald test for groupwise heteroskedasticity in the fixed effect regression model was conducted and, after rejecting the null hypothesis, it can be concluded that heteroskedasticity is present. The next step was conducting the test for serial correlation, where the obtained results indicate that the data do not have first-order autocorrelation. The Pasaran CD test was used to test cross-sectional dependence. The null hypothesis was accepted which means that residuals are correlated. When cross-sectional dependence is present, Hoechle (2007) suggests to use Driscoll and Kraay standard errors.

Finally, the following table presents panel data regression with random effects.

Table 4.

RANDOM EFFECTS MODEL

```
Random-effects GLS regression                   Number of obs     =       190
Group variable: id_country                      Number of groups  =        10

R-sq:                                           Obs per group:
     within  = 0.2508                                         min =        19
     between = 0.5822                                         avg =      19.0
     overall = 0.5687                                         max =        19

                                                Wald chi2(1)      =     67.10
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =    0.0000
```

energ_con	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
t_nights	.0244735	.0029877	8.19	0.000	.0186177	.0303294
_cons	5370.271	2292.542	2.34	0.019	876.9713	9863.57
sigma_u	6982.0033					
sigma_e	1228.0413					
rho	.96999221	(fraction of variance due to u_i)				

Source: author's calculations

The results in Table 4 confirm the relationship between energy consumption in the service sector and tourist overnight stays in selected EU countries in the observed period. The coefficient 0.0244735 indicates that if tourist overnight stays change across time and between countries by one unit, energy consumption would change by an average of 0.0244735 units. The F-test shows that all the coefficients in the model are different from zero. P-value (0.000) confirms the substantial significance of the t_nights variable on the observed variable.

The conducted panel analysis indicates that there is a correlation between the variables at a high level of significance, suggesting that energy consumption in the service sector is caused by the increase in tourist overnight stays. From the previous graphs, it is evident that the highest energy consumption in the service sector is present in Germany, France, Italy, and Spain, and that these countries realized the most tourist overnight stays. In addition, it is evident that the share of energy consumption in the service sector in total energy consumption in the selected countries is between 10% and 15%. Although some other sectors have a higher share of energy consumption, the service sector records growth each year. For that

reason, it is important to monitor the relationship between tourist overnight stays and energy consumption in the service sector and to change the attitude towards energy management, increase energy efficiency, and encourage the use of renewable energy sources (Krstinić Nižić and Blažević, 2017, Tian et al., 2021, Leitão and Balsalobre-Lorente, 2021). In many enterprises, operating costs are second only to the cost of salaries (Mardani et al., 2016). The introduction of new technologies to improve energy management can help to avoid unnecessary costs while reducing total energy consumption and, at the same time, boosting responsibility for environmental protection.

It is evident that some countries have already recognized the importance of reducing energy consumption by raising energy efficiency and have invested in energy efficient technologies. It is estimated that approximately one-fifth of total world energy consumption was supplied from renewable energy sources. In this respect, the role of RESs is growing, and assuming the possibility of RES diversification, is becoming ever more important (Cerović et al., 2014).

5. CONCLUSION AND LIMITATIONS

The main objective of this research was to investigate whether the number of tourist overnight stays impacts energy consumption in the service sector. Empirical research was conducted on a sample of 10 European Union countries in a 19-year period (2000-2018) by examining the relationship between the number of tourist overnight stays and energy consumption in the service sector via the random effects model. The results have confirmed that there is a correlation between the selected variables and that with changes in the number of overnight stays, energy consumption changes as well, i.e., energy consumption is increasing with the increase in tourist overnight stays. The research also shows that the share of energy consumption in the service sector in total energy consumption is between 10% and 15%, and is recording growth from year to year. It is important to note that tourist activity causes energy consumption to increase, and accommodation is the largest contributor to direct energy consumption.

The sustainability of tourism is one of the main focuses in discussions on ecologically integrated tourism development. Thoughtless consumption of energy encouraged by tourism presents a threat not only on local, but also on national and global levels. Each country should implement energy consumption measures in accordance with its own energy goals defined in national strategic documents, as well as supranational strategies, taking into account the broader social wellbeing. The priority should be to increase energy efficiency and the use of energy from

renewable sources in order to reduce energy consumption through fossil fuels (Krstinić Nižić and Blažević, 2017, Santamarta et al., 2021). Improving tourism energy efficiency means using a smaller amount of energy to achieve the same output, which helps promote the green technology and achieve sustainable development (He et al., 2020). Sustainability needs to become a key part of tourism policies and must be present in any tourism development strategy. Well-designed and managed tourism can make a significant contribution to the protection of the environment by promoting the use of environmentally friendly technology and transportation (Koçak et al., 2020). Given that the results of this research imply that tourist overnight stays contribute to energy consumption, with a trend of growth, national economies should further stimulate investment in renewable energy sources in tourism.

The conducted research included only two variables in the analysis, which can be regarded as a certain limitation of this paper. In future research, the analysis could include CO_2 emissions, tourism receipts, energy price, investments in renewable sources, and other relevant variables. One more limitation refers to the choice of 10 European countries. In that respect, the recommendation for future research is to include a larger sample of countries, involving all relevant tourist countries in the world. Compared to the existing empirical research that included GDP, total energy consumption and tourist arrivals, this research includes energy consumption in the service sector, which can be considered the contribution of this paper. This study can provide guidance on energy management to private entities and tourism policy makers in the EU.

These results are especially significant as they represent essential premises and a relevant documentation foundation for making business decisions concerning energy management. Scientists, decision-makers, and managers can use these results to consider the action needed in terms of investments, organization, education, staffing, and other aspects of energy management, in accordance with the specificities of their businesses and the environment. It is evident in this paper that some countries have already recognized the importance of reducing energy consumption by raising energy efficiency and have invested in energy efficient technologies.

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TURISTIČKA POTRAŽNJA I POTROŠNJA ENERGIJE U USLUŽNIM DJELATNOSTIMA: PANEL ANALIZA ODABRANIH ZEMALJA EU

Sažetak

U kontekstu održivog razvoja, smanjenje potrošnje energije i poboljšanje energetske učinkovitosti prepoznati su kao globalni prioriteti. Međunarodni turistički dolasci povećavaju se iz godine u godinu, a turizam bilježi porast potrošnje energije. Međutim, turizam mora prepoznati svoju ulogu u održivom razvoju i dati značajan doprinos korištenjem obnovljivih izvora energije i energetski učinkovite tehnologije. Stoga je cilj ovog rada analizirati odnos između turističkih noćenja i potrošnje energije u uslužnom sektoru u 10 zemalja Europske Unije koje su ostvarile najveći broj noćenja. Istraživanje obuhvaća razdoblje od 19 godina, od 2000. do 2018. Koristi se panel analiza podataka koja proučava povezanost varijabli kroz vrijeme, na temelju metode random efekta. Rezultati pokazuju da postoji povezanost turističkih noćenja i potrošnje energije u uslužnom sektoru, te da se potrošnja energije mijenja s porastom turističkih noćenja. Na temelju provedene analize, nameće se potreba za povećanjem energetske efikasnosti kao i primjenom energije iz obnovljivih izvora kako bi se omogućio održivi razvoj gospodarskog i ekološkog sustava. Empirijski nalazi u ovoj studiji mogu pružiti smjernice upravljanja energijom privatnim i javnim nositeljima turističke politike u EU i Hrvatskoj.

Ključne riječi: turistička noćenja, potrošnja energije, energetska učinkovitost, zemlje EU, panel analiza, random efekt