Jelena Krstić, Marija Reljić*, Sanja Filipović
The Economics Institute, Belgrade, Serbia

Factors Influencing Electricity Consumption: a Review of Research Methods

──────── **Abstract:** ────────

Research Question: This paper presents a review of empirical methods used by authors to determine the influence of different groups of factors that influence households' electricity consumption. **Motivation:** The question of what drives electricity consumption is very complex and requires a systematic approach in analysis of different theory frameworks and factors. In the literature there are a lot of attempts to classify a huge number of very different factors which can be heterogeneous. The review is built on the existing literature by distinguishing the appropriateness of the usage of different empirical methods for collecting the data on the influence of specific groups of factors. **Idea:** Based on significant literature review and analysis of different methods used in this field, the aim of this paper is to make a classification of the most important factors which have the highest impact on electricity consumption. The factors have been grouped into four groups by the authors of the paper. **Data:** The analysis was conducted by reviewing papers dealing with households' electricity consumption published in the international journals. **Tools:** The systematisation of relevant literature was used for the purpose of determining the most common and proper methods that were used for determination of the influence of different groups of factors on electricity consumption. **Findings:** As consumer behaviour in the area of electricity consumption often demands the examination of subjective views of consumers, methods such as interviewing, conduction of online/offline surveys, case study and field experiments are commonly used for analysing the influence of cognitive and affective factors, socio-demographic and behavioural. For the analysis of the impact of contextual factors that includes using the large amount of secondary data, statistical and econometric methods are used as the most appropriate ones. **Contribution:** This paper provides an overview of most appropriate research methods when it comes to examination of the impact of different groups of factors whose influence needs to be empirically proven.

Keywords: electricity, consumption, empirical methods, review, classification, factors

JEL classification: E21, M31

1. Introduction

In the literature and in practice, there has been a growing interest in residential consumption, since it is considered to be at very high levels in many countries, even exceeding the industrial consumption. For this reason, many countries implement different policies to reduce electricity consumption by households, but the results are not always visible. Researchers in the field of consumer behaviour also find this topic interesting and conduct research that has the goal to determine the influence of various factors on electricity consumption and behaviour in order to provide empirical evidence for better policy making.

In the literature, there are several different concepts which have been proposed to classify the numerous interrelated factors influencing energy use. Stern (1999) formulated a typology of the causes of environmentally significant behaviours: attitudinal factors (e.g., perceived costs and benefits of action), personal capabilities (e.g., social status, knowledge) and contextual factors (e.g., regulations, social norms, advertising), and habits and routines. Kollmuss & Agyeman (2002) proposed three categories: demographic, ex-

* Corresponding author: Marija Reljić, e-mail:marija.reljic@ecinst.org.rs

ternal and internal factors. Abrahamse et al. (2005) suggested a distinction between micro-level factors (e.g., attitudes, values, opportunities) and macro-level factors (e.g., economic situation, governmental policies, availability of new technologies). Steg & Vlek (2009) distinguish between motivational, contextual factors and habitual behaviour.

It is widely accepted in the literature that socio-demographic factors, such as household income, ownership, and household size are closely associated with energy usage and demonstrate the highest impact on energy consumption, as well as psychological factors of energy usage (Frederiks et al., 2015). One of them is the approach which highlights the importance of social norms (e.g., Allcott, 2011; Dolan & Metcalfe, 2015). However, empirical research showed that the effects of certain psychological factors (such as values, attitudes and beliefs) on energy behaviour often showed to be weak, especially in comparison with the effects of socio-demographic factors (Abrahamse & Steg, 2009). Considering economic drivers of electricity consumption, the literature is focused on the relationship between energy prices, non-market factors, and electricity consumption and consumer investment in energy efficient-technologies. Burger et al. (2015) developed interdisciplinary approach, based on psychology, economy, consumer behaviour, business science, sociology and political science, which represents one of the most prominent approaches to energy consumption behaviour.

Within various theories, models and frameworks related to energy behaviour, different empirical methods for identifying the patterns of electricity consumption are being used. Therefore, the focus of this paper is on different methods used in empirical research of different groups of factors that need to be systematised.

2. Methodology

The methodology implemented in this paper is based on a review of relevant empirical studies that examine the impact of different factors on the energy-related behaviour of the residential sector. This review is based on a two-fold classification, on the one hand, of empirical methods used by different authors in order to determine the factors that influence energy behaviour and, on the other hand, classification of those factors by using a four-group classification. By grouping previous research by empirical methods that have been used, it is possible to uncover connections among the most suitable research methods for delivering empirical findings related to the influence of different groups of electricity factors. The classification of previous research in order to perform a systematization of the existing knowledge on energy-related behaviour was also employed by Abrahamse et al. (2005), Krysiak & Weigt (2015) and Axon et al. (2018) and was shown to provide valuable information for further research in this area.

For the purpose of the classification of energy factors, authors reviewed typologies previously given by Stern (1999) and Steg & Vlek (2009) and provided a new classification by redefining the factors that belong to each of the groups. As a result, the following four groups are formed:

- Cognitive and affective factors - value systems, norms, beliefs, attitudes, knowledge and skills, motivation and commitment;
- Socio-demographic factors - demografic characteristics of households, social status, life style, living standard, income, place of residence;
- Behavioural factors - habits, routines, behavioural patterns, previous experience;
- Contextual factors – incentives, policy instruments, community actions, electricity price changes, advertising campaigns, communication initiatives, available energy options, technological options.

As the classification was developed for the purpose of grouping the most influential factors when it comes to the changes of electricity consumption, technical factors that may also have a certain impact are left out (such as dwelling size, insulation, characteristics of buildings, etc.) as they can be considered to be constant and, therefore, without changable impact. As regards research methods, it is notable that authors employed the following ones: interviews and surveys and experiments when conducting empirical research aimed at collecting and analysing primary data and econometric and statistical methods when dealing with secondary data. The case study was less used as a research method and was usually combined with surveys.

Papers that were taken into consideration for the purpose of the systematisation were selected based on the following criteria: (a) examination of the influence of factors on electricity consumption of households (residential sector) and (b) being published in well ranked peer-review international journals. The results of the classification can be seen in Table 1.

Table 1: Systematisation of research methods and examined factors

Author(s)	Research method(s)[+]	Scope of the research	Groups of factors			
			Cognitive and affective	Socio-demographic	Contextual	Behavioural
Abrahamse et al. (2007)	FE, SU	Groningen, Netherlands (314 households)	X			X
Allcott (2011)	FE	USA (600,000 households)			X	
Attari et al. (2010)	SU	USA metropolitan areas (505 participants)	X			
Azaza & Walin (2017)	ES	Sweden				X
Barnicoat & Danson, (2015)	IN	Scotland (19 households)	X	X		
Borozan (2017)	ES	Croatia			X	
Belaid (2016)	SU	France (36,000 households)		X	X	
Burchell et al. (2016)	FE	London (400 households)			X	
Carrico & Riemer, (2011)	FE, SU	USA 2.300 participants			X	
Chen (2017)	CS, ES	Taiwan		X	X	
Ding et al. (2017)	ES	China		X		X
Ekholm et al. (2010)	ES	India (rural area)		X	X	
Ekins et al. (2011)	ES	EU			X	
Frick et al. (2004)	SU	Switzerland (2736 participants)	X			
Gram-Hanssen (2010)	IN	Denmark (30 households)			X	
Gram-Hanssen (2011)	CS	Copenhagen, Denmark	X			X
Huebner et al. (2016)	ES	UK (845 housholds)	X	X		X
Jingchao & Kotani (2012)	SU, ES	rural districts in Beijing, China (756 households)		X	X	
Lenzen et al. (2006)	ES	Australia, Brazil, Denmark, India and Japan		X		
Martinez-Espineira et al. (2014)	ES	Spain (13,382 households)	X	X	X	
Pablo-Romero et al. (2017)	ES	Regional		X	X	
Rahman et al. (2017)	CS, SU	Malaysia	X			X
Reiss & White (2008)	ES	San Diego, USA			X	
Romanach et al. (2017)	SU	Brisbane, Australia (1647 households)		X		X
Shen et al. (2017)	FE, ES	Hangzhou, China (179 households)		X	X	X
Strengers et al. (2016)	IN	Sydney, Australia (80 households)	X			X
Sun et al. (2018)	ES	Jiangsu province, China				X
Wallis et al. (2016)	SU	Dortmund, Germany (763 households)		X		
Wang et al. (2018)	IN, ES	Yuncheng, China (236 households)			X	

Note: [+]IN - In-depth interview, SU – survey (online/offline), FE (field experiments),
ES – econometric/statistical methods, CS – case study
Source: Authors

3. Presentation and Discussion of Research Methods and Examined Factors

In-depth interviewing

As seen from the provided classification, in-depth interviewing is dominantly used in case of the examination of the influence of cognitive and affective and behavioural factors in the area of electricity consumption, although it can be used in case of other two groups of factors to a significant degree. For example, Strengers, Nicholls & Maller (2016) interviewed energy consumers with the goal of revealing their awareness of the role of non-traditional actants in energy consumtion and their usual behavioural patterns. Gram-Hanssen (2010) aimed to determine the ways energy-related practices can be modified as a result of communicative

initiatives aimed at educating household members on how to reduce consumption, which represents a contextual factor. The research results indicated that communication incentives may lead to the changes of everyday behavioural routines, level of knowledge and motivation to make behavioural changes. Barnicoat & Danson (2015) examined the attitudes of older household members towards electrical appliances usage and adoption of energy saving instruments, with special emphasis on the level of their acceptability of energy saving instruments (smart metering, external control of home appliances and heating). The results indicated that insufficient knowledge of energy efficiency of appliances and energy costs and the lack of willingness to adopt smart technologies of interviewees were the main causes of inappropriate electricity consumption patterns.

Wang et al. (2018) conducted an interview with the goal to examine the potential responses of Chinese households to electricity price changes by assuming that real-time electricity pricing in the residential sector represents an effective factor to change consumption patterns and promote electricity conservation. In addition to interviews, the authors used agent-based modelling and showed that real-time pricing has the potential to impact households' electricity consumprion by shifting the load from peak to off-peak periods of the day and reduce total consumption. Jingchao and Cotani (2012) combined interviewing with regression analysis in order to estimate the energy demands of rural households. The results showed that, among socio-economic characteristics, the per capita income represented the main factor of the energy consumption. Also, certain contextual factors (changes of energy source prices and availability of environmentally friendly technologies) influence the consumption. In particular, the change of prices exhibited negative effects on the use of these energy resources, while availability of technologies was shown to improve energy efficiency.

Online/offline surveys

As an alternative to interviewing, some authors conducted surveys where participants were polled by using online or offline questionnaires. This method is suitable for larger samples, and for all four groups of factors, although most often for cognitive and affective factors. This method was used by Attari et al. (2010), who aimed to determine consumer attitudes regarding energy conservation and reduction of climate changes. The majority of participants noted activities related to energy use and savings (such as turning off lights and driving less) as more effective in terms of energy conservation than efficiency improvements (such as installation of more efficient light bulbs and home appliances). The authors also concluded that participants with more prominently expressed pro-environmental attitudes demonstrated more precise estimations. Setting interest on the similar topic, Frick et al. (2017) examined the role that environmental knowledge has in the sphere of promotion of conservation behaviour. The findings showed that action-related knowledge and effectiveness knowledge have a direct impact while system knowledge mediated influence on energy behaviour. Belaid (2016) intended to determine the influence of socio-economic and contextual factors on household's' energy consumption within different population groups. Among contextual factors taken into consideration, energy prices appeared to be the most important factor that affects domestic energy consumption. Also, household characteristics (lifestyle and place of residence) were also found to be significant since the families living in rented dwellings showed to consume less energy than those who own their living places, and those who live in rural areas consume more energy than households in suburbs. Wallis et al. (2016) examined the influence of socio-demographic factors (social status and income, number of residents, and number of adolescents within household) on electricity consumption. Results indicated that the mentioned socio-demographic characteristics influence energy behaviour of the households. By using a survey-based data on a sample of households with older inhabitants, Romanach et al. (2017) found out that socio-demographic factors (age, income, place of residence), as well as behavioural patterns in the household appliances use, influence energy consumption.

Field experiments

Field experiments, especially randomized control trials (RCTs), have become a useful and commonly used method in consumer behaviour studies in different areas, consequently in the area of consumption as well. These usually include the existence of experimental and control groups and demand implementation of precise experimental design. RCTs on household electricity consumption vary regarding the applied interventions, however, most commonly those interventions relate to the influence of contextual factors. Burchell et al. (2016) implemented experimental design in exploration of the impact of two contextual factors (community action and communication initiatives) on the behaviour change in the area of energy consumption. Participating households were exposed to experimental stimuli in the form of advice on seasonal energy saving

and information about different local and national events and programmes dedicated to energy saving. As a result of this field experiment, statistically significant differences in knowledge between the consumption of the experimental and that of the control group were obtained. Abrahamse et al. (2007) conducted a field experiment with the goal to determine the effectiveness of different experimental interventions (contextual factors) in the aspect of changes in direct and indirect energy use and energy-related behaviour. In order to determine the impact of these interventions, participants filled out online questionnaires three times in the course of the study. Also, households in experimental groups accepted more energy-saving behaviours and demonstrated more knowledge of energy conservation during the study in comparison with the households in the control group.

The impact of contextual factors is most often examined in RCTs by providing energy saving tips and cost/consmption feedback (Houde et al., 2013). Allcott (2011) conducted randomized natural field experiment in order to determine the influence of sending feedback on households' energy consumption and the comparison in relation to neighbouring households which were sent by energy supplying company. For this kind of interventions, large-scale field experiments only find modest electricity consumption reductions (Allcott, 2011; Allcott & Rogers, 2014). Carrico & Riemer (2011) set a goal to determine the way and the extent to which peer education and feedback are significant factors in reducing energy consumption by conducting a cluster-randomized field experiment. The results indicated the decrease in the consumption in the experimental groups (by 7% and 8%), while, consumption during the intervention phase increased within the control group (by approximately 4%). Shen et al. (2017) combined two methods in their research. First, they conducted an energy conservation experiment by using the tailored information with eco-feedback as the main intervention variable and then applied Support Vector Regression (SVR) model for consumption prediction, which was found to be influenced by 18 predicting factors (including energy behaviours, personality and demographic characteristics). Furthermore, RCTs are often used for testing the impact of dynamic pricing schemes and effects of different tariff schemes on the behaviour of the participating households, as was the case in the study conducted by Wolak (2011).

Case study

Gram-Hanssen's (2011) research consisted of three case studies with the goal of examining changes in household energy consumption by focusing on the impact of cognitive factors (existing knowledge) and behavioural factors (embodied habits, engagement and technology usage). It was shown that different types of changes occur as a consequence of different factors, especially behavioural ones. Rahman et al. (2017) combined the case study method with surveying of households in three suburban areas in Malysia in order to determine different
behavioural consumption profiles of households and link them to the level of energy efficiency. Also, household awareness (cognitive factor) and practice (behavioural factor) appeared to be important factors related to high electricity consumption. Chen (2017) combined the case study method with statistical methods in order to examine the indirect impact of contextual factors (gross domestic product /GDP, employment rates, energy labeling schemes) on residential electricity consumption by their influence on the socio-economic factors (life-style, living standard of households) which stimulates an increased electricity demand, and, potentially, higher consumption.

Econometric and statistical methods

In cases when there is a significant amount of existing data regarding the impact of certain factors (mainly contextual) on consumption, the authors decide to perform econometric or statistical analyses and to determine certain trends in energy consumption. Also, such methods are commonly used when it is necessary to perform a cross-country or a cross-regional comparisons. Such was the case of authors Pablo-Romero et al. (2017) who conducted an analysis of trends in residential energy consumption over the period of two decades, from the perspective of 11 main world regions and by per capita gross national income levels. They noted significant differences at regional levels among main regions worldwide. They concluded that the EU15, Eastern and Southern Asian countries and other developed countries represent the regions that should invest the largest efforts possible to reduce energy consumption at the residential level. Lenzen et al. (2006) conducted a five country analysis by using available national statistical data. As a result, significant differences in average energy requirements were discovered, even at the same residential income levels and consumer lifestyles (socioeconomic factors). Ekins et al. (2011) assessed the distributional implications of environmental tax reform on households' consumption at the level of the EU. They used the modelling of the influences of main environmental tax reforms as a methodological approach, which in-

cluded the use of an ex-ante scenario-based approach for estimation of future developments. Modelling results showed that environmental tax reform will likely induce the changes in residential consumption, even though there are differences among countries and for different socio-economic groups.

Borozan (2017) implemented the panel unit tests with and without structural breaks in order to examine the impact of regional differences on electricity consumption in Croatia during the period of twelve years. The author showed the existence of inter-country regional differences and emphasised the necessity to evaluate such differences when formulating energy policy measures aimed to decrease residential electricity consumption. Earlier, Reiss & White (2008) tried to determine behavioural reactions of large population to monetary and non-monetary contextual factors. The findings showed that an average household consumption decreased by 13% during two months as a reaction to an unannounced increase of energy price. Also, the results indicated that an average energy consumption at the household level significantly decreased during public appeals for energy conservation performed by state, even though it did not include any changes in prices, which clearly pointed out to the effectiveness of non-monetary incentives. Sun et al. (2018) aimed to discover the regional difference of household electricity consumption by dividing households into different groups according to behaviour factors such as consumption volatility and behavioural pattern similarity.

In addition to cross-country or cross-regional research, econometric and statistical methods are also applied in national-scope research by some authors. Martinez-Espineira et al. (2014) focused on the impact of socio-demographic characteristics, environmental attitudes and beliefs and the impact of environmental awareness campaigns on a household's behaviour and implemented a multivariate probit model. Huebner et al. (2016) tested to what extent different types of factors (among them socio-demographics, attitudes and self-reported behaviours) explain electricity consumption of residents by comparing four separate regression models. The results indicated that socio-demographic factors caused 21% of the variability in electricity consumption, the usage of appliances caused 34% of variability, while the impact of self-reported energy-related behaviour and pro-environmental attitudes showed to be negligible. Based on the input-output analysis, Ding et al. (2017) examined the direct and indirect impacts of household consumption on the total energy consumption from the consumers' lifestyle perspective. The authors found out that household energy consumption amounts to approximately one fourth of the total finial consumption, with the indirect consumption being 1.35 times higher than the direct one. Azaza and Walin (2017) implemented a mining approach on smart meter data with the goal of identifying consumer groups who are the most responsible for the electricity network peaks. Also, authors applied two clustering approaches – hierarchical clustering and self-organizing map and determined five clusters of customers with different behavioural patterns. Ekholm et al. (2010) applied the modelling approach to analyze the influence of different energy options and income distributions, as well as other factors such as preferences and discount rate on consumption.

Conclusion

By analysing different empirical studies, it was found that different groups of factors influence electricity consumption. The majority of the factors that have an impact on electricity consumption are still insufficiently well understood and empirically tested even though the body of evidence is enlarging. In literature, many factors analysed separately or in combination could be found, while their impact on electricity consumption is more complex and requires the application of different research methods. However, the aim of this research is not to provide an answer or to create consensus on the most proper methods when it comes to the effects of certain factors, but rather to raise understanding of the possibilities for determination of the influence of different factors which have an impact on electricity consumption. It was shown that different factors, including contextual ones, as well as those related to households' characteristics are significant determinants of energy consumption and, therefore, should be taken into consideration when designing campaigns for energy consumption reduction in order to achieve higher energy efficiency at the national level.

In practice, the knowledge about drivers of households' electricity consumption and conservation, alongside the nature and the scope of their impact, can provide a valuable foundation for development of the cost-effective public policies promoting energy efficiency. A precise definition of the impact of relevant factors and their empirical validation and better understanding of the relationship between them is the prerequisite for developing evidence-based policy approach.

REFERENCES

[1] Abrahamse, W., Steg, L., Vlek, C. & Rothengatter, T. (2005). A review of intervention studies aimed at household energy conservation. *Journal of Environmental Psycholog*y, 25, 273-291. DOI: 10.1016/j.jenvp.2005.08.002

[2] Abrahamse, W., Steg, L., Vlek, C. & Rothengatter, T. (2007). The effect of tailored information, goal setting, and tailored feedback on household energy use, energy-related behaviours, and behavioural antecedents. *Journal of Environmental Psychology*, 27, 265–276. DOI: 10.1016/j.jenvp.2007.08.002

[3] Abrahamse, W., & Steg, L. (2009). How do socio-demographic and psychological factors relate to households' direct and indirect energy use and savings? *Journal of Economic Psycholog*y, 30, 711–720. DOI: 10.1016/j.joep.2009.05.006

[4] Allcott, H. (2011). Social norms and energy conservation. *Journal of Public Economics*, 95 (9), 1082-1095. DOI: 10.1016/j.jpubeco.2011.03.003

[5] Allcott, H., & Rogers, T. (2014). The Short-Run and Long-Run Effects of Behavioural Interventions: Experimental Evidence from Energy Conservation. *The American Economic Review* 104 (10), 3003–3037. DOI: 10.1257/aer.104.10.3003

[6] Attari, S.Z., DeKay, M.L., Davidson, C.I. & de Bruin, W.B. (2010). Public perceptions of energy consumption and savings, Proceedings of the National Academy of Sciences, 107 (37) 16054-16059; DOI: 10.1073/pnas.1001509107

[7] Axon, S., Morrissey, J., Aiesha, R., Hillman, J., Revez, A., Lennon, B., Salel, M., Dunphy, N., & Boo, E. (2018). The human factor: Classification of European community-based behaviour change initiatives. *Journal of Cleaner Production*, 182, 567-586. DOI: 10.1016/j.jclepro.2018.01.232

[8] Azaza, M. & Wallin, F. (2017). Smart meter data clustering using consumption indicators: responsibility factor and consumption variability. *Energy Procedia*, 142, 2236-2242. DOI: 10.1016/j.egypro.2017.12.624

[9] Belaid, F. (2016), Understanding the spectrum of domestic energy consumption: Empirical evidence from France. *Energy Policy,* 92, 220–233. DOI: 10.1016/j.enpol.2016.02.015

[10] Borozan, D. (2017). Testing for convergence in electricity consumption across Croatian regions at the consumer's sectoral level. *Energy Policy*, 102, 145–153. DOI: 10.1016/j.enpol.2016.12.018

[11] Burchell, K., Rettie, R. & Roberts, T.C. (2016). Householder engagement with energy consumption feedback: the role of community action and communications. *Energy Policy*, 88, 178–186. DOI: 10.1016/j.enpol.2015.10.019

[12] Burger, P., Bezençon, V., Bornemann, B., Brosch, T., Carabias-Hütter, V., Farsi, M., Hille, S.L., Moser, C., Ramseier, C., Samuel, R., Sander, D., Schmidt, S., Sohre, A., & Volland. B. (2015). Advances in understanding energy consumption behaviour and the governance of its change – outline of an integrated framework. *Frontiers in Energy Research*, 29(3). DOI: 10.3389/fenrg.2015.00029

[13] Carrico, A.R. & Riemer, M. (2011). Motivating energy conservation in the workplace: An evaluation of the use of group-level feedback and peer education. Journal of Environmental Psychology, 31(1), 1-13. DOI: 10.1016/j.jenvp.2010.11.004

[14] Chen, YT. (2017). The Factors Affecting Electricity Consumption and the Consumption Characteristics in the Residential Sector—A Case Example of Taiwan. Sustainability, 9, 1484; DOI:10.3390/su9081484

[15] Ding, Q., Cai, W. & Wang, C. (2017). Impact of household consumption activities on energy consumption in China: evidence from the lifestyle perspective and input-output analysis. *Energy Procedia*, 105, 3384 – 3390. DOI: 10.1016/j.egypro.2017.03.767

[16] Dolan, P. & Metcalfe, R. (2015). Neighbors, knowledge, and nuggets: Two natural field experiments on the role of incentives on energy conservation. *Becker Friedman Institute for Research in Economics Working*, Paper No. 2589269. DOI:10.2139/ssrn.2589269

[17] Ekholm, T., Krey, V., Pachauri, S. & Riahi, K. (2010). Determinants of household energy consumption in India. *Energy Policy*, 38, 5696-5707. DOI:10.1016/j.enpol.2010.05.017

[18] Ekins, P., Pollitt, H., Barton, J., & Blobel, D. (2011). The implications for households of environmental tax reform (ETR) in Europe. *Ecological Economics*, 70, 2472–2485. DOI: 10.1016/j.ecolecon.2011.08.004

[19] Frederiks, E.R., Stenner, K. & Hobman, E.V. (2015). The Socio-Demographic and Psychological Predictors of Residential Energy Consumption: A Comprehensive Review. *Energies*, 8(1), 573-609. DOI: 10.3390/en8010573

[20] Gram-Hanssen, K. (2011). Understanding change and continuity in residential energy consumption. *Journal of Consumer Culture*, 11(1), 61–78. DOI: 10.1177/1469540510391725

[21] Gram-Hanssen, K. (2010). Standby consumption in households analysed with a practice theory approach. *Journal of Industrial Ecology*, 14(1), 150–165. DOI: 10.1111/j.1530-9290.2009.00194.x

[22] Houde, S., Todd, A., Sudarshan, A., Flora, J. A., & Armel, K. C. (2013). Real-time Feedback and Electricity Consumption: A Field Experiment Assessing the Potential for Savings and Persistence. Energy Journal, 34(1). 87-102. DOI: 10.5547/01956574.34.1.4

[23] Huebner, G., Shipworth, D., Hamilton, I., Chalabi, Z. & Oreszczyn, T. (2016). Understanding electricity consumption: A comparative contribution of building factors, socio-demographics, appliances, behaviours and attitudes. *Applied Energy*, 177, 692–702. DOI: 10.1016/j.apenergy.2016.04.075

[24] Jingchao, Z. & Kotani, K. (2012). The determinants of household energy demand in rural Beijing: Can environmentally friendly technologies be effective? *Energy Economics*, 34, 381–388. DOI:10.1016/j.eneco.2011.12.011

[25] Kollmuss, A. & Agyeman, J. (2002). Mind the gap: why do people act pro-environmentally and what are the barriers to pro-environmental action? *Environmental Education Research*, 8(3), 239-260. DOI: 10.1080/13504620220145401

[26] Krysiak, F.C. & Weigt, H. (2015) The Demand Side in Economic Models of Energy Markets: The Challenge of Representing Consumer Behaviour, Frontiers in Energy Research 3, DOI: 10.3389/fenrg.2015.00024

[27] Martinez-Espineira, R., García-Valiñas, M. A. & Nauges, C. (2014). Households' pro environmental habits and investments in water and energy consumption: Determinants and relationships. *Journal of Environmental Management*, 133, Available at: 174-183. DOI: 10.1016/j.jenvman.2013.12.002

[28] Pablo-Romero, M.d.P., Pozo-Barajas, & R., Yñiguez, R. (2017). Global changes in residential energy consumption. *Energy Policy*, 101, 342–352. DOI: 10.1016/j.enpol.2016.10.032

[29] Rahman, K.A., Leman, A.M., Faris Mubin, M., Yusof, M.Z.M., Hariri, A., & Salleh, M.N.M. (2017). Energy Consumption Analysis Based on Energy Efficiency Approach: A Case of Suburban Area. MATEC, 87, 02003. DOI: 10.1051/matecconf/20178702003

[30] Reiss, P.C., & White, M.W. (2008). What changes energy consumption? Prices and public pressures. The Rand Jornal of Economics, 39 (3), 636-663. DOI: 10.1111/j.1756-2171.2008.00032.x

[31] Romanach, L., Hall, N. & Meikle, S. (2017). Energy consumption in an ageing population: exploring energy use and behaviour of low-income older Australians. *Energy Procedia*, 121, 246-253. DOI: 10.1016/j.egypro.2017.08.024

[32] Shen, M., Sun, H. & Lu, Y. (2017). Household electricity consumption prediction under multiple behavioural intervention strategies using Support Vector Regression. *Energy Procedia*, 42, 2734-2739. DOI: 10.1016/j.egypro.2017.12.218

[33] Steg, L. & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology*, 29 (3). 309-317. DOI: 10.1016/j.jenvp.2008.10.004

[34] Stern, P. C., Dietz, T., Abel, T., Guagnano, G. A., & Kalof, L. (1999). A value-belief-norm theory of support for social movements: The case of environmentalism. Human Ecology Review, 6(2), 81-97. Retrieved from:

[35] Strengers, Y., Nicholls, L. & Maller, C. (2016). Curious energy consumers: Humans and nonhumans in assemblages of household practice. *Journal of Consumer Culture*, 16(3), 761–780. DOI: 10.1177/1469540514536194

[36] Sun, L., Zhou, K., & Yang, S. (2018). Regional difference of household electricity consumption: An empirical study of Jiangsu, China. *Journal of Cleaner Production*, 171, 1415-1428. DOI: 10.1016/j.jclepro.2017.10.123

[37] Wallis, H., Nachreiner, M. & Matthies, E. (2016). Adolescents and electricity consumption; Investigating sociodemographic, economic, and behavioural influences on electricity consumption in households. *Energy Policy*, 94, 224–234. DOI: 10.1016/j.enpol.2016.03.046

[38] Wang, H., Fang, H., Yu, X., & Liang, S. (2018). How real time pricing modifies Chinese households' electricity consumption. Journal of Cleaner Production, 178, 776-790. DOI: 10.1016/j.jclepro.2017.12.251

[39] Wolak, F.A. (2011). Do residential customers respond to hourly prices? Evidence from a dynamic pricing experiment. American Economic Review, 101 (3), 83–87. DOI: 10.1257/aer.101.3.83

//////////////////////////////////// **About the Authors**

Jelena Krstić
Economics Institute, Belgrade, Serbia
jelena.cvijovic@ecinst.org.rs

Jelena Krstić holds a Ph.D. in organizational sciences and works as a research associate and a member of the Scientific Board at the Economics Institute in Belgrade, Serbia. Her research interests are related to scientific fields of marketing communications, public relations and consumer behaviour. She has participated in various research projects in different economic fields. She has so far published one monograph and more than 40 papers in international and national journals and conference proceedings.

Marija Reljić
Economics Institute, Belgrade, Serbia
marija.reljic@ecinst.org.rs

Marija Reljić works as a research associate and project manager at the Economics Institute in Belgrade, Serbia. Her research interests are related to scientific fields of market research, renewable energy sources, consumer behaviour, human capital and entrepreneurship. During her professional carrier she has been involved as a project manager or as a team member on more than 20 research projects in different economic fields. She has so far published more than 20 papers in international and national journals and conference proceedings.

Sanja Filipović
Economics Institute, Belgrade, Serbia
sanja.filipovic@ecinst.org.rs

Sanja Filipovic is a senior research fellow at Economics Institute and full professor at the Singidunum University. She has a broad experience and is highly familiar with economic policy and regulatory issues. During her professional carrier she has been involved in preparation of many national strategic documents and more than 70 different projects/studies mainly financed by international organizations (EC, OECD, GTZ, WB, UNEP, etc.).