***ANALYZING HETEROGENEITY AMONG RESIDENTIAL ENERGY CONSUMERS IN SLOVENIA: THE ROLE OF INTEGRATED ENERGY SERVICES***

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## Overview

Energy markets are undergoing a major transition mainly driven by new market strategies aimed at increased consumer engagement and climate change policies. The transition that started with deregulation of energy markets has not only increased market competition but has also enriched the suppliers’ offers with the variety of additional services including green energy and energy efficient technologies (IEA, 2011; McDaniel & Groothuis, 2012). Consumers are now free to select an energy supplier as well as to choose from various energy products, on the basis of not only the price, but also several other factors impacting consumer preference for supplier’s offer (service quality, service process quality, additional services, environmental commitment, brand trust, etc.) (Wüstenhagen & Bilharz, 2006; Hartmann & Apaolaza- Ibáñez, 2012). Since consumer preferences are becoming more diverse with the expanded offer, it is important to understand how consumers make decisions on energy products and services when those decisions necessitate trade-offs between various benefits and costs (Yang, Solgaard, & Haider, 2015). Energy suppliers are therefore forced to transform into active, toward consumer-oriented utilities with emphasis on the enhancing use of integrated energy services while simultaneously promoting environmental sustainability (Kaenzig, Heinzle, & Wüstenhagen, 2013).

The main objective of our study is to investigate preference heterogeneity among Slovenian residential electricity consumers and to ascertain how different consumer groups value different attributes of energy products and services. In particular, we will be interested in identifying the segment of consumers that shows preference for integrated energy services (IES), among them services associated with energy efficient and green behaviour. The content of the present paper can contribute to the overall development of the energy markets since it encourages market participants, particularly energy suppliers, for further development of new market strategies aimed at differentiation of energy products and services. Future development of the energy market will be directed toward creating an effective and integrated service mix with providing maximum benefits to consumers as well as creating new business opportunities for suppliers.

## Methods

The theoretical framework of analysing consumer preference for integrated energy services is based on a probabilistic approach to determine the unobserved (i.e. latent) class membership of individuals, named latent class analysis (LCA). The analysis is conducted in two steps. In the first, principal component analysis (PCA) (Hair, Black, Babin, & Anderson, 2014) with Varimax rotation is performed to extract orthogonal principal component (PC) solution among six constructs of stated preferences for IES. Examination of appropriateness of the PCA was carried out using Bartllet’s Test of Sphericity. Moreover, confirmatory factor analysis (CFA) was employed to confirm the structure of extracted PCs. However, the preferences for IES may differ among underlying consumer classes. In the second step, LCA is employed to capture this heterogeneity (Collins & Lanza, 2010). LCA enables to divide consumers into different classes on the basis of their expressed preferences and consequently enhance understanding of consumer behavioural dynamics (Walker & Ben-Akiva, 2002). It assumes that there exists a finite number of subgroups of individuals (i.e. classes) with heterogeneous preferences between groups and homogeneous preferences within groups (Walker & Ben-Akiva, 2002). Classification variables were PCs, extracted from six constructs of preferences for IES, obtained from the PCA explained above. In order to identify latent consumer classes, we added explanatory variables, namely, attitude and behaviour toward green energy and energy efficient technologies, as well as satisfaction with the supplier, average monthly electricity consumption (i.e. electricity bill), consumption and usage of additional services, and other socio-economic and socio-demographic characteristics of contract holders (education, monthly income and the number of household members), as covariates in the subsequent latent class regression. The latter enables to estimate the effects of covariates on predicting latent class membership.

Our sample consists of consumers buying electricity from one of the biggest energy companies in Slovenia, which also operates in more than 10 energy markets in Central and South Eastern Europe. After deregulation, the company extended its offer with a package offer of several energy sources (electricity, LPG, natural gas, heating oil and petroleum products) as well as with other energy related services (online billing system, automatic meter reading, online shopping and energy efficiency consultations). Using its database of electricity consumers, 5,466 consumers were selected in order to gather the data with an online survey using self-administered questionnaire in February 2016. The final sample consists of 984 consumers (18% response rate) - holders of the electricity supply contracts with the supplier. The data were merged with the supplier’s database containing consumers’ information about their energy consumption.

## Results

In the first step of analysis, among six IES constructs of consumer preference for IES, PCA has extracted a three-PC solution: (1) a low price and related savings as well as reliable supply (*reliable and* *low price services*); (2) an extended offer of additional services including an option of green energy and energy efficient technologies (*additional services and energy efficiency*); and (3) collaboration between consumer and supplier, active market communication, quality of information provided by the supplier as well as the supplier’s brand reputation (*consumer relationship management*). The structure of extracted PCs was reliably confirmed by CFA. In the second step, those PCs were employed as the classification variables in the latent class analysis (LCA). The number of latent classes depends on both; the model fit information as well as the explanation power. We assess model fitness with several model fit indicators including the Bayesian Information Criterion (BIC), Akaike Information Criterion (AIC) and quality of classification or entropy. When estimating our model with the LCA, we assessed one to six class solutions. Results show that BIC favours 4-class solutions while AIC prefers 5-class solution. Although both BIC and AIC suggest the larger class solution, the entropy value indicates that the smaller (a 3 class solution) is more appropriate, since it gives the most reasonable explanation and the size of each consumer class was sufficiently large for further examination.

The results of LCA reveal that consumers are heterogeneous when comparing different dimensions of energy services. Three consumer classes were identified; the *value-seeking* (47%) consumers, the *energy efficient* consumers (36%) and the *apathetic* consumers (17%). As expected, the most important dimension for all consumer classes is low price and reliability of the services. However, differences in preferences exist between the largest classes, value-seeking and energy efficient. Consumers of the latter prefer additional services and energy efficiency rather than good relationship with supplier, while value-seeking consumers just the opposite. Furthermore, latent classes also differ in terms of parameter estimations of covariates i.e. their attitude and behaviour toward green energy and energy efficiency (EE) as well as in terms of their socio-demographic profiles. Compared to the value-seeking consumers, energy efficient consumers are more satisfied, express interest in, and also use EE technologies, especially to achieve energy related cost reductions. They also demonstrate higher energy saving habits in households (HH). Apathetic consumers are, in comparison to the value-seeking consumers, less satisfied, not interested in decreasing energy related costs and neither invest or intend to invest in EE in HH.

## Conclusions

Our findings reinforce the theoretical and empirical underpinnings that the understanding and responding to heterogeneous consumers is a prerequisite for remaining competitive on the energy market, where integration of energy services could be applied to achieve this goal. The results of LCA reveal that energy efficient consumers prefer additional servicesto good relationship with the supplier, while for the value-seeking consumers just the opposite holds. In line with the found consumer preference heterogeneity, identified by the characterization of these classes, our study provides managerial implications for the energy suppliers. Energy suppliers should differentiate their energy products and services and design different information campaigns and marketing strategies for various consumer segments. Energy efficient consumers are already prepared to invest in EE, while value-seeking consumers have to be motivated. Various solutions, such as online billing system and consumption monitoring as well as energy efficiency consultations, may be required, in order to enhance their involvement and EE activity. Consumer retention programs should also focus more on this segment of consumers as it was found they tend to be less satisfied with the supplier.

# References

Collins, L. M., & Lanza, S. T. (2010). *Latent class and latent transition analysis: with applications in the social behavioral, and health sciences.* Hoboken, NJ: Wiley.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2014). *Multivariate data analysis.* Upper Saddle River, NJ: Pearson Education.

Hartmann, P., & Apaolaza- Ibáñez, V. (2012). Consumer attitude and purchase intention toward green energy brands: the roles of psychological benefits and environmental concern. *Journal of Bussines Research, 65*(9), 1254-1263.

IEA. (2011). *Empowering customer choice in electricity markets.* Paris, France: International Energy Agency.

Kaenzig, J., Heinzle, S. L., & Wüstenhagen, R. (2013). Whatever the customer wants, the customer gets? Exploring the gap between consumer preferences and default electricity products in Germany. *Energy Policy, 53*, 311-322.

McDaniel, T. M., & Groothuis, P. A. (2012). Retail competition in electricity supply—Survey results in North Carolina. *Energy Policy, 48*, 315-321.

Walker, J., & Ben-Akiva, M. (2002). Generalized random utility model. *Mathematical Social Sciences, 43*, 303-343.

Wüstenhagen, R., & Bilharz, M. (2006). Green energy market development in Germany: effective public policy and emerging customer demand. *Energy Policy, 34*(13), 1681–1696.

Yang, Y., Solgaard, H., & Haider, W. (2015). Value seeking, price sensitive, or green? Analyzing preference heterogeneity among residential energy consumers in Denmark. *Energy Research & Social Science*, 15-28.