HSC Research Report

HSC/15/07

Social acceptance of green energy and dynamic electricity tariffs – a short review

Anna Kowalska-Pyzalska[1]

[1] Department of Operations Research, Wrocław University of Technology, Poland

Hugo Steinhaus Center
Wrocław University of Technology
Wyb. Wyspiańskiego 27, 50-370 Wrocław, Poland
http://www.im.pwr.wroc.pl/~hugo/

Social acceptance of green energy and dynamic electricity tariffs – a short review

Anna Kowalska-Pyzalska
Department of Operations Research
Wroclaw University of Technology, Wroclaw, Poland
anna.kowalska-pyzalska@pwr.edu.pl

Abstract - **This paper presents a review of recent literature on consumer energy behaviors and willingness to pay for innovative products on the energy market. Among such products green energy and dynamic electricity tariffs will be considered. Social and psychological factors, that influence the adoption of these products will be discussed. Consumer engagement and acceptance of green energy as well as dynamic electricity tariffs are necessary to make the diffusion of these products possible and effective. In conclusion some research challenges and potential research gaps will be described.**

Keywords - ***dynamic pricing; green energy; social acceptance; consumer behavior; willingness to pay; diffusion of innovation***

I. INTRODUCTION

Nowadays the energy market experiences many challenges all over the world. The power system of the future has to be more sustainable, built on a greater energy efficiency and a high share of renewable energy with decreased production of CO_2 emissions. These changes will certainly impact the energy consumers, their daily routines and bills for electricity. The ambitious political goals (e.g. 3x20 Policy) will not be achieved without consumers' awareness and engagement. In the last couple of years, the position of electricity consumers in the power system has radically changed. Due to market decentralization and the presence of a growing number of renewable energy sources (RES) on the lower voltage levels, new possibilities have arisen for the consumers. They can now play an active role in the power system. They have the right to change the energy supplier, as a result of the Third Party Access policy, see [1] and to choose a specific pricing program. Moreover, they can now relatively easily start to generate energy and use it for their own needs or sell the surplus to the distribution system operators. In this way they can become prosumers, i.e., consumers, who consume and produce energy at the same time.

The question is whether consumers are aware of all these new opportunities and whether they are ready and willing to contribute to the efficiency and sustainable development of the power system. Since years scientists from various disciplines: electricians, psychologists, environmentalists, etc. discuss and research the motivations of consumers' energy behaviors. Hundreds of publications have been written and many experimental tests and surveys have been conducted. Recently, as many surveys reveal, consumers become more environmentally conscious and in most cases they declare their willingness to pay a higher price for green energy as well as willingness to reduce energy consumption by signing to the demand side management/ demand response (DSM/DR) programs (e.g. choosing dynamic electricity tariffs, like time-of-use or real-time pricing) [2-5]. Moreover, investigators argue whether and how environmental beliefs and attitudes result in more environmental behavior, like energy conservation by i.e. choosing dynamic electricity tariffs or paying more for green energy, see e.g. [6-8]. The research has shown that even strong environmental beliefs and pro-environmental attitudes do not always lead to environmental behavior (so called intention-behavior-gap) [8-10].

The most important question that arises is how to convince the consumers to change their energy behaviors? How can they be persuaded to pay more for green energy or to sign to the dynamic pricing programs, which are a crucial type of DSM/DR tools? How to convince consumers to the products which often guarantee either higher bills for electricity (green energy) or discomfort of change in the daily routine (dynamic tariffs)? Further, what influences the social acceptance of these products?

Some answers to these questions will be presented in this paper. This paper aims to shortly summarize the results of the last research of environmental behavior towards green energy and dynamic electricity tariffs. The paper focuses on the social and psychological factors that influence the adoption of these products on the market and the consumer acceptance. In the coming section some general issues regarding diffusion of innovative products on the energy market will be presented. Then, some most popular and experimentally proved energy behavior models and frameworks will be mentioned. Section IV will explain the most important antecedents of willingness to pay and social acceptance. Finally, still open research questions and scientific challenges will be presented.

II. DIFFUSION OF GREEN ENERGY AND DYNAMIC TARIFFS IN THE ENERGY MARKET

Following Rogers' concept, a typical innovation adoption process consists of 5 sequential stages: gaining knowledge of an innovation, forming an opinion (attitude) towards it (persuasion stage), deciding to adopt or reject it, implementing it and finally, confirming the decision [11]. The first stage of gaining knowledge about the innovation is essential, as the consumers must be aware of the innovation [10, 12]. As Claudy [12] notices, most of the surveys and researches assume that consumers are aware of the existence of the innovative products, like green energy od dynamic tariffs. However, as the authors emphasize, it doesn't have to be always true. Many consumers might not have spent much time considering these green innovations or, more importantly, are not aware of their existence at all. Consumer awareness depends on the backgrounds or market segment of the consumers and the specific technology in question [10, 12].

In case of green energy, although a great political and financial efforts have been made, there is still a lot to do to increase the diffusion of renewable energy sources on the energy market. The adoption of dynamic tariffs by the consumers is also still in progress. As pilot programs and surveys showed, it is hard to convince people to switch to dynamic pricing and most of the consumers present disengagement and indifference towards DSM/DR tools [3, 4, 10, 13].

Diffusion of green energy and dynamic tariffs cannot be explained without knowledge about the relationship between attitudes and behaviors of the consumers. Models and frameworks that aim to simulate the diffusion of innovative products, are based on some assumptions from socio-economic or psychological theories of decision making. Some most common energy behavior models and frameworks will be presented below.

A. Energy behavior models and frameworks

Modeling of consumers' energy behavior as well as diffusion of green energy and dynamic tariffs is a topic of many scientific publications [6-8, 10, 14-17]. The authors usually base on one of the social or economic theories explaining the process of opinion formation and decision making. Some most common examples of these theories are mentioned below: microeconomic utility-based theory of consumer's decision making, economic models of behavior connected with consumer's demand dependent on the price and income elasticity, technology adoption and attitude-based theory of planned behavior (TPB), decision theories in social and environmental psychology (like, Values-Belief-Norm Theory), sociological theories that cover the influence of social context in decision making (like, cultural model of household energy consumption [5, 9, 14, 19-23]. Most of the above mentioned theories assume rationality of the consumers. In reality a lot of behavior takes place under conditions of bounded rationality. Due to the various factors, like: lack of time for the proper analysis, limited information about issues and options, limited processing capacity, lack of interest and laziness, risk and loss aversion, consumers use various heuristics and perform either a habitual behavior or choose an option which looks satisfactory for them, rather than make an optimal choice [9, 10, 22].

What is common to all the energy behavior models and frameworks is the goal to explain how people make decisions, how their attitudes, beliefs, norms and values impact their behavior. Many scientists agree that understanding of the consumer behavior is necessary to design the proper attributes of the product in such a way that the consumers will adopt it [14, 15, 22, 24-26].

One of the most famous theories explaining the relationship between people's beliefs and norms, attitudes towards behavior and behavior itself is the theory of planned behavior (TPB) by Ajzen [18] and its earlier form called the theory of reasoned action (TRA). Apart from attitudes and behaviors, TPB introduces also a third variable, control beliefs. Control beliefs are people's perceptions of how easy or difficult it is to perform the behavior in relation to their abilities, resources and opportunities, which will encourage or hinder the performance [8, 18]. One of the controllability factors is cost: there are always consumers who are reluctant to pay extra and who are not eager to change their daily routine in case of dynamic tariffs [6, 8]. The are many modern models and frameworks of environmental behavior which take some assumptions from TPB (for green energy [8, 15], for dynamic tariffs [6, 17, 27]).

The next group of normative models of pro-environmental behavior is built on the relationship between values and behavior [15, 20, 28]. Values, as defined by Schwartz, are general psychological factors that guide a wide range of specific attitudes, beliefs, preferences and behaviors [20, 29]. They can be understood as guiding principles in a person's life [19, 29]. In the Schwartz's theory, values are organized along two bipolar dimensions that present opposition between competing values (tradition versus openness to change and self-transcendence versus self-enhancement). As some authors measured, pro-environmental attitudes and behaviors are positively related to an altruistic or self-transcendence value orientation, while negatively related to an opposite egoistic or self-enhancement value orientation (focused on one's personal wealth and status) [19, 21]. It was found that individuals who expresses a positive attitudes towards green energy are more concerned about the adverse consequences of environmental problems for humans and the biosphere thus possibly prioritizing collective or altruistic values [19]. Individuals with self-transcendence value orientation who believe in and are concerned about the adverse consequences of environmental problems for human and biosphere usually believe that green energy has positive impact on the environment (by e.g. reducing fossil-fuels emissions). That is why, such consumers will evaluate green electricity positively. On the contrary, individuals with a self-enhancement value orientation who are concerned about the negative effects of required sacrifices (e.g. paying more) will evaluate green energy negatively [19, 21]. In the Steg's analysis the values define which costs and benefits of energy alternatives are most vital to people and guide their acceptability ratings [21].

Another popular model for pro-environmental behavior is called the new ecological paradigm scale (NEP Scale), successor of the new environmental paradigm (NEP) by Dunlap and Liere [28]. This model is characterized with a set of core values, which emphasize respect for natural limits and the importance of preserving the balanced integrity of nature. A model of pro-environmental consumer behavior by Stern [20] called the value-belief-norm model (VBN) is based on the concept of the NEP. VBN theory suggests that biospheric, altruistic and egoistic values affect a person's acceptance of the NEP values. Normative beliefs have a positive effect on the intention to adopt environmental behavior; for example what matters in the intention to engage in environmental behavior is the belief that climate change has to be dealt with and everyone needs to do something about it [8, 20]. Consumers feel responsible when they understand what is occurring and the consequences of their actions. Such moral obligations increase the probability of taking energy behaviors [8, 10, 12].

The contingent valuation methods, field experiments, survey questionnaire, semi-structured interviews and online surveys, used in the research of energy behavior and social acceptance, make a usage of the theories presented above and let the authors to identify motivational, contextual and habitual factors that impact environmental behavior. Motivations, from an individual perspective, as Lopez et al.

TABLE 1. THREE DIMENSIONS OF SOCIAL ACCEPTANCE TOWARDS GREEN ENERGY AND DYNAMIC TARIFFS

Type of acceptance	**Socio-political acceptance**	**Community acceptance**	**Market acceptance**
By whom	Public, key stakeholders, policy makers	Local stakeholders (residents and local authorities)	All market players, especially consumers (but also investors)
Of what	Technologies and policies	Siting decisions and RES projects	RES (understood rather as particular technologies than generically)
Comments	- Even if the public support for green energy seems to be high, moving from global to local level and from general support for technologies and policies to effective investment and decisions decrease rapidly the acceptance [33].	- Problem with NIMBY (Not in My Backyard) – some people accept the investment projects in RES as long as they are not directly affected by them. - Collective costs and benefits (environmental impact, safety of operation), then individual costs and benefits (price, quality of energy supply, physical characteristics of energy alternative), fairness-related characteristic (like fair procedures, compensation strategies) and finally psychological factors (values, trust and place-identity) must be taken into account [21].	- The type of financial support and the way the green energy market is organized is crucial to gain all players interest and acceptance [12].
How to overcome the obstacles and to increase the acceptance?	- Establish reliable financial support to create options for new investors. - Prepare spatial planning systems that stimulate collaborative decision making [33].	- Increase trust of local community in information given and intentions of the investors and actors outside the community. - Take care about procedural and distributional justice: Is the decision process fair? Does it take all actors into account? How should costs and benefits been shared between the actors? - Important institutional factors affecting public acceptance include ownership status, political governance, bureaucratic problems and information and public participation [21, 33].	- Focus on precise market segmentation (taking into consideration different needs and expectations of various consumers groups) - The importance of increasing energy conservation by usage of dynamic pricing should be better explained to the consumers (residential, firms).

[22] emphasize, lead people to engage in environmental behavior and are divided into perceived costs and benefits, moral and normative concerns and affection. According to the first motivation, people make more or less consciously a cost-benefit analysis of the alternatives, weigh pros and cons, to maximize their benefits. The second motivation is related to the valuation of environmental beliefs and concerns, the moral obligation to act pro-environmentally and the influence of social norms on behaviors [22]. Finally, the third make use of affective and symbolic factors to explain environmental behavior. Further, the authors underline that these different perspectives are not mutually exclusive and all of them should be considered to predict environmental behaviors [5-8, 15, 16, 22, 30-32].

III. SOCIAL ACCEPTANCE

Wuestenhagen, Wolsing and Buerer distinguish three dimensions of social acceptance: socio-political (broadest, most general level), community (public acceptance) and market acceptance (market adoption of innovation) [33]. Some issues regarding these three acceptance levels are presented in the Table 1.

A. Determinants of the consumers' willingness to pay

Only if the social acceptance is accompanied by the consumers' engagement and willingness to pay (WTP), understood as a willingess to contribute (by paying more for green energy, by becoming a prosumer, by switching to the dynamic tariffs program), the true adoption of such products is possible. The table below gathers the results of some studies, exploring the correlation between willingness to pay and socioeconomic characteristics of the consumers, regarding green energy and dynamic tariffs, see Table 2. [5, 8, 14-16, 21, 34]. The difference between willingness to pay (sometimes called also stated willingness to adopt (SWA)) and the actual adoption has been widely researched [1, 7-8, 34]. On one hand WTP or SWA for green energy are quite high in Europe and in U.S. (WTP between 40-60% and SWA between 30-60%). On the other hand the actual number of consumers switching to green tariffs is low (average adoption rate in U.S. is below 2% and in Europe even lower). This social phenomenon is called intention-behavior-gap and will be shortly explained in the next sub-section.

B. Intention-behavior gap

The main difficulty in understanding the energy behavior is to realize how humans attitudes and beliefs are correlated with actual behaviors and willingness-to-pay for certain products (e.g. green energy). The basic observation of psychology is that people's attitudes towards some ideas or products do not have to be followed by actual decisions and behaviors. As Ozaki emphasizes, positive green attitudes towards pro-environmental behaviors do not necessarily translate into the performance of the behaviors [8]. The problem that intentions do not always translate into actions can be better understood on the two following examples. The recent Italian survey has shown that while 70% of respondents declared willingness to increase energy saving, only 2% were currently reducing their use [10]. AIU Power Smart Pricing Program in USA has shown that only 18% of customers were aware of the pilot program, only 10% understood the program, only 5% were interested in it, and finally less than 1% have really enrolled in the program [13].

TABLE 2. CORRELATIONS BETWEEN WILLINGESS TO PAY AND SOCIO-ECONOMIC FACTORS

Willingness to pay is correlated	
positivly with:	negativly with:
- positive attitudes towards green energy or energy conservation	- non-voluntary programs
- self-transcendence values	- self-enhancement values
- income level	- electricity cost
- educational level	- household size
- knowledge about energy issues and awareness of the climate issues	- extra cost of supporting technologies (smart meters, in home displays) in case of dynamic tariffs
- concern about environmental problems	- age
- experience in investing in green energy	- rural population
- urban population	

The gap between declared intentions and actual actions is called the intention-behavior-gap (IBG) or the value-action gap and has been the subject of many studies [1, 6-8, 17, 27]. For instance, Diaz-Rainey and Tzavara [1], as well as Ozaki [8], argue that among factors that may cause stated preferences to diverge from the actual behavior the following can be mentioned: unstable consumers' opinions, lack of knowledge of the green power availability, confusion generated by the complexity of tariffs, lack of guidelines and advice, lack of sufficient supply, a hesitancy to switch from one electricity supplier to another, distrust of energy product suppliers and cost concerns, search cost involved in switching and free rider problem.

On the other hand, Kowalska-Pyzalska et al. [17] take a bottom-up approach and use an agent-based model originating in sociophysics [35-38] to study the discrepancies between customers' opinions and decisions towards dynamic electricity tariffs. Considering consumer indifference towards tariffs (parameter p), impact of rational information and advertisement via an external field (parameter h) and social influence (conformity) they argue that the intention-behavior gap is mainly caused by the instability of opinions (one day an agent may be in favor of the tariff, the other day he/she may be against it). This can be observed in Fig. 1. In the left panel, for high indifference (p; meaning that consumers do not care about the kind of electricity tariff they have) no matter how high the external field (h) is, the ratio of agents having a positive opinion towards dynamic tariffs converges to 0.5. In the right panel we can see that the resulting ratio of decisions is close to 0 (in this example it is assumed that a positive decision towards a dynamic tariff is possible only when the agent has positive opinions towards it for τ = 60 days). The decisions follow the opinions only for low values of indifference. The higher the indifference level, the greater the intention-behavior gap can be observed. Even if the opinions (intentions) are in majority, they are not followed by decisions (to switch to a dynamic electricity tariff from the traditional, flat one).

There are various factors that increase the chance of social acceptance of the innovative products. Among them let us just mention the outcome of cost-benefit analysis, usability, price control, convenience of signing up and what the innovation means to the consumers, for example, the way it reflects their identity, image, memberships, values and norms. Many researchers showed that strong social norms, are needed to encourage adoption [6, 8, 9, 30, 31, 35-38]. Without social norms, people cannot judge whether adopting a new energy service is accepted or not. The role of social influence is important: people show their sense of membership by taking up activities that are regarded as a norm within the group they belong to [8].

C. Social influence

The recent studies have proved that normative social influence has a positive effect on the intention to engage in environmental behaviors [8, 30, 31, 39, 40]. It has been found that strong social norms encourages the adoption of various pro-environmental behaviors, like e.g. acceptance of green energy or energy conservation behavior, see [8]. The literature suggests that consumers are favorably influenced by the opinions and actions of their family, friends and associates [7, 17, 25, 26, 35-41]. Therefore the social dimension of consumer behavior and engagement need to be carefully taken into account [31].

As Ozaki noticed, social and personal identity and values can be represented by a person's level of consumption or adoption of green electricity [8]. Moreover, in the work of Bollinger et al., social interaction through so called peer effects are recognized as a potentially important factor in the diffusion of new products. In that study, the impact of peer effects on household decisions about the installation of solar photovoltaic (PV) panels have been shown [42]. The more PV were installed on average in the certain area, the higher was the probability of the adoption and further increase of new installations.

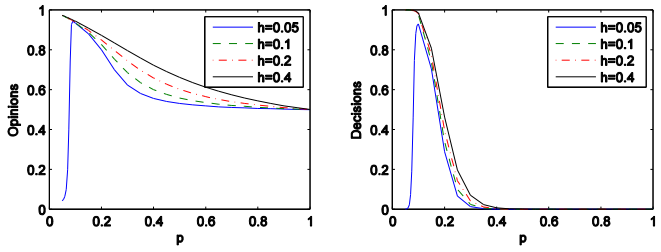

Fig. 1. Dependence between opinions (left panel) or decisions (right panel) and the level of indifference (p) for selected values of the external field (h) after t = 720 Monte Carlo time steps, based on the unanimity of τ = 60 past opinions.

Nolan et al. has argued that a social norm has a greater impact that other non-normative motivations like: protection of environment, benefiting society or even saving money. Moreover, in that study the inconsistency between stated motivation and actual behavior has been revealed. Because "others are doing it" was judged to be the least important reason at the self-reported motivation stage. But the highest correlation with actual conservation behavior was a person's belief whether or not their neighbors were doing it, see [30].

The impact of the neighbors behavior have been also revealed in the studies of Alcott and Ayers [31, 39]. Both studies report on the large-scale program, run by the OPOWER, who sent so called Home Energy Report Letters

to residential utility customers comparing their electricity use to that of their neighbors. By the means of this action, the energy consumption has been reduced by 2%. It was shown that combining the descriptive and injunctive messages (in this case, the emoticons: happy or sad faces) lowered energy consumption and reduced the undesirable boomerang effect (that those who occurred to use less energy in comparison with the neighbors started to increase their consumption), see [31]. According to Ayers et al., learning that neighbors consume less (more) energy could increase (decrease) feelings of guilt about contributing to social problem and thereby impact private preferences and motivations to conserve [39]. Alternatively, learning the behavior of neighbors might provide information about the possibility of alternative consumption choices and the relative benefits of those choices.

To conclude, consumer engagement in energy conservation is influenced by social and personal norms [30, 31, 43, 44] To achieve the best results in diffusion of innovation and reduction of energy consumption both: normative and descriptive norms should be combined [30, 31, 39]. That is why the social pressure cannot be neglected in diffusion of green energy and dynamic tariffs. Seeking information from personal contacts, referred to as the mobilization of social capital, could potentially promote the diffusion of energy-reducing innovations.

IV. Conclusions

The main findings of the research and analysis of social acceptance towards innovative green energy and dynamic pricing are as follows:

- Pro-environmental attitudes and beliefs do not always translate into environmental behavior (intention-behavior-gap). This is due to lack of strong social norms and personal relevance, inconvenience of switching, uncertainty about the quality of green electricity or confusion of choosing between various dynamic electricity tariffs and lack of accurate information and advice.
- To increase the chance of effective adoption by consumers it is necessary to overcome obstacles of behavioral change, like perception, self-interest and limited knowledge (including awareness, understanding and procedural knowledge of the innovation) [9,10].
- To fill the gap between intentions and actual behavior the benefits from adoption need to have personal relevance to encourage potential adopters to take action.
- From various promoting strategies of more efficient energy behaviors, those based on feedback mechanisms seem to bring best results [9, 22, 30, 31]. It is so, because people compare themselves to their neighbors and the motivation “because others are doing it” seem to be very crucial.
- Social norms and innovations influence each other: when more people adopt an innovation, the innovation itself becomes a norm, which encourages even more people to adopt it [8].
- Strategies promoting DSM or green energy policy and programs must be designed according to the consumer profile to make it more effective. Market segmentation and market analysis is needed [12, 22]. Level of consumers’ awareness of the innovation should be investigated and the marketing strategy and promotion should be designed according to it.
- Green power is not generated generically, but often it is promoted generically. Research has shown that consumers do not perceive green energy sources as equivalent and that it is important to specify the source of green power when estimating preferences and utility [16].
- Finally, to make the adoption of innovative green energy and dynamic tariffs effective the consumers must perceive more benefits and positive consequences from adopting than costs. They must think that adopted products are in agreement with their values, beliefs and current practices. They have a feeling of control and they accept to pay extra money for the adopted products or to suffer from discomfort (of rescheduling their daily routine). Last but not least they have a support of others members of the community who are also becoming adopters (social influence and norms).

Although a large number of studies, analysis and research about environmental behavior and social acceptance towards green energy and dynamic tariffs has been done, there are still a lot of open questions or issues that must be further researched. Among them, the following can be mentioned [5, 15, 16, 33]: What are the crucial factors in acceptance of particular green energy, e.g. PV-modules, solar power plants, off-shore wind power, biogas installation, biomass power plants etc.? What is it that really makes people buy renewable energy and how does this key motivation differ between customer segments? Do community residents appreciate and accept specific types of RES? How should the policies and marketing strategies be defined to increase the acceptance of RES? How can programs, policies and market incentives contribute to the establishment of RES? How to translate national policy objectives into locally accepted policies? How to determine the extent to which consumers believe that their choices of green electricity and dynamic tariffs have an effect on the production of green electricity and sustainable development of the power system, since the outcome of their choices cannot be possible observed? These and many other scientific questions still need to be researched in order to propose better, more effective promoting strategies of innovative products: green energy and dynamic electricity tariffs and to assure their successful adoption on the energy market in the future.

Acknowledgments

This work was partially supported by funds from the National Science Centre (NCN) through grant no. 2013/11/B/HS4/01061.

References

[1] Diaz-Rainey I., D. Tzavara, “Financing the decarbonized energy system through green energy electricity tariffs: A diffusion model of an induced consumer environmental market”. Technological Forecasting & Social Change 79, 2012, pp. 1693-1704.

[2] FORSA, Erfolgsfaktoren von Smart Metering aus Verbrauchersicht, Report 2010 (in German).

[3] OFGEM Consumer First Panel (2011), http://www.ofgem.gov.uk.

[4] ATKearney, HAN within Smart Grids, Report (in Polish), 2012

[5] E.K. Stigka, J.A. Paravantis, G.K. Mihalakakou, “Social acceptance of renewable energy sources: A review of contingent valuation applications”, Renewable and Sustainable Energy Reviews 32, 2014, pp. 100–106.

[6] D. Gadenne, B. Sharma, D. Kerr, T. Smith, “The influence of consumers’ environmental beliefs and attitudes on energy saving behaviors”, Energy Policy 39, 2011, pp. 7684–7694.

[7] J. Picket-Baker, R. Ozaki, R. “Pro-environmental products: marketing influence on consumer purchase decisions”. The Journal of Consumer Marketing 25(5), 2008.

[8] R. Ozaki, “Adopting sustainable innovation: What makes consumers sign up to green electricity?” Business Strategy and the Environment 20, 2011, pp. 1-17.

[9] M. Baddeley, “Energy, the environment and behavior change: a survey of insights from behavioral economics”, 2011 (working paper).

[10] F. Pongiglione, “Climate change and individual decision making: an examination of knowledge, risk perception, self-interest and their interplay”, FEEM Working Paper, Fondazione Eni Enrico Mattei, 2011.

[11] E.M. Rogers, “D iffusion of Innovations” 5th Edition, Free Press, New York, 2003.

[12] M.C. Claudy, C.Michelsen, A. O’Driscoll, M.R. Mullen, “Consumer awareness in the adoption of microgeneration technologies. An empirical investigation in the Republic of Ireland”. Renewable and Sustainable Energy Reviews 14 (2010), pp. 2154–2160.

[13] A.Star, M. Isaacson, D. Haeg, L. Kotewa, “The dynamic pricing mousetrap: Why isn’t the world beating down our door?” ACEEE Summer Study on Energy Efficiency in Buildings 2010, Proceedings 2, 2010, pp. 257-268.

[14] S. Gyamfi, S. Krumdieck, T. Urmee, “Residential peak electricity demand response - Highlights of some behavior alissues”. Renewable and Sustainable Energy Reviews 25, 2013, pp. 71–77.

[15] A.Hansla, A. Gamble, A. Juliusson, T. Gaerling, “Psychological determinants of attitude towards and willingness to pay for green electricity”. Energy Policy 36, 2008, pp. 768-774.

[16] A.M. Borchers, J.M. Duke, G.R. Parsons, “Does wilingness to pay for green energy differ by source?”. Energy Policy 5, 2007, pp. 3327-3334.

[17] A.Kowalska-Pyzalska, K. Maciejowska, K. Suszczyński, K. Sznajd-Weron, R. Weron, “Turning green: Agent-based modeling of the adoption of dynamic electricity tariffs”. Energy Policy 71, 2014, pp. 164-174.

[18] I. Ajzen, “The theory of planned behavior”. Organizational Behavior and Human Decision Process 50(2), 1991, pp. 179-211.

[19] K. Ek, “Psychological determinants of attitude towards “green” electricity: the case of Swedish wind power”. Energy Policy 33, 2005, pp. 1677-1689.

[20] P.C. Stern, “Towards a coherent theory of significant environmental behavior”, Journal of Social Issues, 56(3), 2000, pp. 407-424.

[21] G. Perlaviciute, L. Steg, “Contextual and psychological factors shaping evaluations and acceptability of energy alternatives: Integrated review and research agenda”. Renewable and Sustainable Energy Reviews 35, 2014, pp. 361–381.

[22] M.A.R. Lopes, C.H. Antunes, N. Martins, “Energy behaviors as promoters of energy efficiency: A 21st century review”, Renewable and Sustainable Energy Reviews 16, 2012, pp. 4095– 4104.

[23] L.A. Lutzenhiser, “A cultural model of households energy consumption”. Energy 17(1), 1991, pp. 47-60

[24] Faires, M.Cook, C. Neame, “Towards a contemporary approach for understanding consumer behavior in the context of domestic energy use”, Energy Policy 35(8), 2007, pp. 4381-4390.

[25] W. Jager, “Stimulating the diffusion of photovoltaic systems: a behavioral perspective”. Energy Policy 34(14), 2006, pp. 1935-1943.

[26] D.K. Sidiras, E.G. Koukios, “Solar systems diffusion in local markets”. Energy Policy 32(18), 2004, pp. 2007-2018.

[27] T. Zhang, W.J. Nuttall, “Evaluating government’s policies on promoting smart metering diffusion in retail electricity markets via agent-based simulation”. Journak of Product Innovation Management 28, 2011, pp. 169-186.

[28] R.E. Dunlap, K.D.V. Liere, A.G. Mertig, R.E. Jones, “New trends in measuring environmental attitudes: measuring endorsement of the new ecological paradigm: a revised NEP scale”. Journal of Social Issues 56(3), 2000, pp. 425-442.

[29] S.H. Schwartz, “An overview of the Schwartz theory of basic values. Online reading in psychology and cultire: http://scholarworks. Gvsu.edu/orpc/vol2/iss1/11/.

[30] J.M. Nolan, P.W. Schultz, R.B. Cialdini, N.J. Goldstein, V. Griskevicius, V., “Normative social influence is underdetected”. Personality and Social Psychology Bulletin, 34, 2008, pp. 913-923.

[31] H. Allcott, “Social norms and energy conservation”. Journal of Public Economics 95(9-10), 2011, pp. 1082-1095.

[32] L. Steg, C.Vlek, “Encouraging pro-environmental behavior: an integrative review and research agenda”. Journal of Environmental Psychology, 29(3), 2009, pp. 3550-3557.

[33] R. Wuestenhagen, M. Wolsing, M.J. Buerer, “Social acceptance of renewable energy innovation: an introduction to the concept”. Energy Policy 35 (2007), pp. 2683-2691.

[34] J. Zarnikau, “Consumer demand for ‘green power’ and energy efficiency”, Energy Policy 31(5), 2003, pp. 1661-1672.

[35] P. Przybyła, K. Sznajd-Weron, R. Weron, “Diffusion of innovation within an agent-based model: Spinsons, independence and advertising”, Advances in Complex Systems 17(1), 2014, 1450004.

[36] K. Sznajd-Weron, J. Szwabiński, R. Weron,“Is the person-situation debate important for agent-based modeling and vice versa?”, PLoS ONE 9(11), e112203, 2014.

[37] K. Sznajd-Weron, J. Szwabiński, R. Weron, T. Weron, “Rewiring the network. What helps an innovation to diffuse?”, Journal of Statistical Mechanics P03007 (doi:10.1088/1742-5468/2014/03/P03007), 2014.

[38] P. Nyczka, K. Sznajd-Weron, “Anticonformity or Independence? - Insights from Statistical Physics”, Journal of Statistical Physics 151, 2014, pp.174-202.

[39] Ayres I., S. Raseman, A. Shih, “Evidence from Two Large Field Experiments that Peer Comparison Feedback Can Reduce Residential Energy Usage”, The Journal of Law, Economics, and Organization Advance Access published August 20, 2013 (working paper).

[40] M. McMichael, D. Shipworth, “The value of social networks in the diffusion of energy-efficiency innovations in UK households”. Energy Policy 53, 2013, pp.159–168.

[41] F. Gangale, A. Mengolini, I. Onyeji, “Consumer engagement: An insight from smart grid projects in Europe”. Energy Policy 60, 2013, pp. 621–628.

[42] B. Bollinger, K. Gillingham, “Peer effects in the diffusion of solar photovoltaic panels”. Marketing Science, 31, 2012, pp. 900–912.

[43] W. Schultz, J.M. Nolan, R.B. Cialdini, N. Goldstein, V. Griskevicius, “The constructive, destructive and reconstructive power of social norms”. Psychological Science 18, 2007, pp. 429-434.

[44] G.D. Jacobsen, M.J. Kotchen, G. Clendenning, “Community-based incentives for environmental protection: the case of green electricity”. J Regul Econ 44, (2013), pp. 30–52.

HSC Research Report Series 2015

For a complete list please visit http://ideas.repec.org/s/wuu/wpaper.html

01 *Probabilistic load forecasting via Quantile Regression Averaging on sister forecasts* by Bidong Liu, Jakub Nowotarski, Tao Hong and Rafał Weron

02 *Sister models for load forecast combination* by Bidong Liu, Jiali Liu and Tao Hong

03 *Convenience yields and risk premiums in the EU-ETS - Evidence from the Kyoto commitment period* by Stefan Trück and Rafał Weron

04 *Short- and mid-term forecasting of baseload electricity prices in the UK: The impact of intra-day price relationships and market fundamentals* by Katarzyna Maciejowska and Rafał Weron

05 *Improving short term load forecast accuracy via combining sister forecasts* by Jakub Nowotarski, Bidong Liu, Rafał Weron and Tao Hong

06 *A hybrid model for GEFCom2014 probabilistic electricity price forecasting* by Katarzyna Maciejowska and Jakub Nowotarski

07 *Social acceptance of green energy and dynamic electricity tariffs – a short review* by Anna Kowalska-Pyzalska