

INCENTIVISING LOAD SHIFTS FROM RESIDENTIAL CUSTOMERS

Are gamification and normative feedback based approaches more effective than time based tariffs?

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Overview

One of the great challenges in balancing fluctuations in electricity supply is to motivate residential customers to take a more active role and provide their load flexibilities in order to improve the system efficiency. However, in Europe dynamic tariffs are offered as opt-in tariffs and consequently most residential customers still have constant tariffs and do not provide any load flexibility. The main limiting factors are that many potential adopters to dynamic tariffs do not “walk their talk” (Tabi et al., 2014, p. 212) and price spreads on the electricity wholesale markets as well as the price elasticity of residential customers are far too low for providing sufficient economic incentives for load shifting (Lijesen, 2007). Furthermore, consumers show adverse reactions to the inherent complexity of dynamic tariffs (Layer et al., 2017). One recent glimmer of hope are incentives, which are based on gamification or normative feedback (cf. Gamma 2016, Lossin et al., 2016a, b). This study is a first investigation of comparing different incentive schemes in Germany that could be used for motivating residential customers to make their electricity demand more flexible. Time-based electricity tariffs are compared to normative feedback and gamification-based incentives in order to identify differences in their effectivity.

Methods and Data

Our conceptual model is depicted in Figure 1. 10 hypotheses are analysed, which focus on different influences on the intention of residential electricity consumers to provide load flexibilities due to different incentive schemes, i.e. time-based dynamic tariff (e.g. Time of Use – TOU), normative feedback or a gamification-based incentive. As the main mediators, we consider different personal needs (such as “adjusting to others” or “positive feeling of self-worth”) as well as expected experiences of flow and joy when being faced with the incentive scheme. Furthermore, we consider “perception of social belonging to the reference group” and “gaming experience” as moderators.

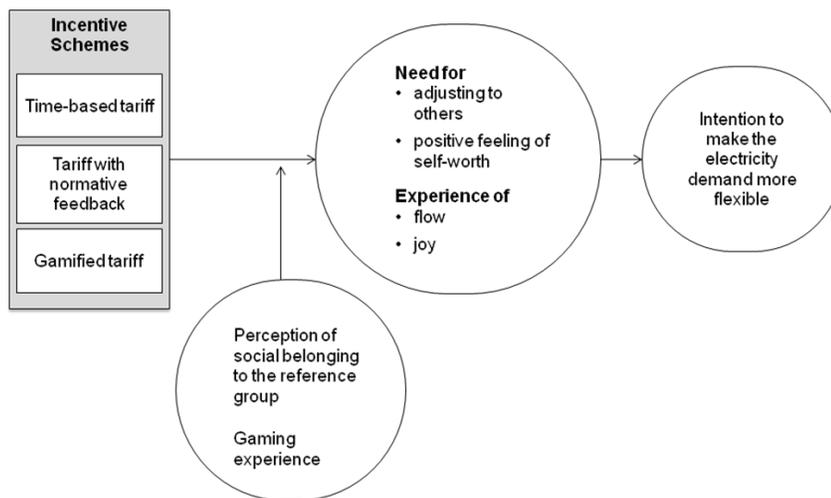


Fig. 1: Hypothesis model of factors influencing the intention to make the electricity demand more flexible

We utilized a commercial consumer panel to recruit 344 individuals to participate in our online survey (November 2016). The sample was representative of the German population between 20 and 70 years in terms of education, age and gender. We used a one-factorial (incentive scheme: time-based tariff vs. tariff with normative feedback vs. gamified tariff) between subjects design. The participants were randomly assigned to one of the scenarios and were asked to imagine that they had decided for the respective tariff described. The tariff with normative feedback displayed the user’s energy saving performance compared to the average household in their neighborhood. The gamification-based tariff offered the user several activities within a game, like collecting coins, challenging another player or updating their public gaming profil. Each of these activities were linked to an energy saving measure, which therefore could be realized in a playful way. The following survey questions referred to the users behavior

and feelings in the given situation. All latent constructs (Need for adjusting to others, Need for positive feeling of self-worth, Experience of flow, Experience of joy, Perception of social belonging to the reference group, Intention to make the electricity demand more flexible) were measured using multi-item scales (all Cronbach's Alphas > .9). The items were measured on a scale from 1 to 7.

Results

The results of the online experiment revealed that the tariff with normative feedback and the gamification-based tariff influence the user in a more emotional way compared to the time-based electricity tariff. It was found that the tariff with normative feedback has a more positive effect on the user's need for adjusting to others (contrast = .44; $p < .05$) and a more positive effect on the user's need for a positive feeling of self-worth (contrast = .56; $p < .05$) than the time-based tariff. The gamified tariff was confirmed to have the most positive effect on the user's experience of flow (contrast = .80; $p < .01$) and on the user's experience of joy (contrast = .96; $p < .001$). However in all three scenarios the participants showed an equal intention to increase their electricity demand flexibility ($F(2,331) = .865$, n.s.). A regression analysis showed that these needs and experiences are positively related with the user's intention to increase the flexibility of residential electricity demand ($F(4,329) = 31.256$; $p < .001$, all VIF < 5). The influence of the user's perception of social belonging to the reference group and the influence of the user's gaming experience could not be confirmed in the statistic evaluation. However, it was found that the effectiveness of the different incentive schemes are depending on the user group. For households with low income the time-based tariff seems to be most effective. With increasing income level the normative feedback becomes the most effective incentive scheme ($b = .46$; $p < .05$). It was also found that women are more likely to be influenced by the gamified tariff and men are more likely to be influenced by the time-based tariff ($b = -1.08$; $p < .05$). The data also reveals how likely the users would take certain steps to reduce or shift their electricity demand. It was found that the participants willingness to shift demand was generally higher than their willingness to reduce their demand. The participants stated in the questionnaire that they are most willing to reduce their electricity demand by „switching off unnecessary lights“ (which usually has almost no effect on the load) followed by „having a light meal instead of a hot meal“ and „reducing the time watching TV“. The participants were least willing to „increase the temperature of their fridge or freezer within certain limits“.

Conclusions

Today, the potential load flexibilities of residential are still unused in Europe even though it would support the energy transition. Dynamic tariffs as opt-in variants failed to attain this flexibility. By applying a hypothesis model in combination with a representative online survey we analysed whether normative feedback or gamification-based incentives influence the consumers more intensively and therefore have a stronger impact on their intention to increase their flexibility in electricity demand compared to time-based tariffs. Our results indicate that indeed the time-based tariff seems to give the weakest incentive to adapt loads. Moreover the results showed that the effectiveness of incentive schemes clearly differ between user groups. Hence, a user-centric allocation of incentive schemes might be an effective instrument to enhance the load flexibility of residential. In addition the study provides an answer to what motivates consumers to make their electricity demand more flexible, as the results indicate the personal needs and feelings of consumers are related to their consumption behavior.

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