INCENTIVES TO GO GREEN: AN EMPIRICAL INVESTIGATION OF MONETARY AND SYMBOLIC REWARDS TO MOTIVATE ENERGY SAVINGS

Research

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Abstract

Green information systems have been shown to contribute to environmental sustainability and help to prevent associated problems. Private households account for 25% of primary energy consumption in western countries, and therefore hold a great potential to curb the use of fossil fuels and prevent climate change. As such, green information systems should not focus solely on the organizational context, but also target a single individual's behaviour in their home. Personal information systems (e.g., web portals) can achieve this focus, however, need to be actively used to produce effects. System usage can be effectively motivated through incentives, and therewith contribute to positive outcomes. Incentives are either monetary or non-monetary and can be implemented in different scales. In a large field experiment (n= 2,355), with real energy customers of a utility company, we tested the effectiveness of different types and sizes of incentive in motivating active system usage. We show that incentives significantly increased system usage of participants, and additionally increased energy savings. However, monetary incentives were not necessarily superior to non-monetary incentives.

Keywords: Green IS, motivation, incentive alignment

1 Introduction

Within the last 40 years, the global primary energy demand has doubled (International Energy Agency, 2015). While this development went hand in hand with many highly encouraging trends such as increasing life expectancies and a much smaller share of people living in absolute poverty, the growing hunger for fossil fuels has detrimental effects not only on the climate but also raises questions regarding energy security and imposes a threat to geopolitical stability. As a response to this development, ambitious policy measures have been put in place. One prominent example is the 20-20–20 targets of the European Union (EU) that aim for a 20% reduction of greenhouse gas emissions (compared to 1990 levels) in the EU, a share of renewable energy sources of 20%, and a 20% increase in energy efficiency by 2020. Both, the supply and demand side have to undergo massive changes in order to reach these goals. On the demand side, residential consumers have been identified to hold a large potential to effectively reduce fossil fuel use and thus carbon emissions to mitigate climate change (Dietz et al., 2009). Residential energy consumption accounts for approximately 25% of primary energy consumption and 20% of CO_2 emissions in the US and Europe (European Environment Agency, 2012). Importantly, within households, consumption varies greatly. This is largely due to differences in the efficiency of appliances (e.g., efficiency of heating system) and usage behaviours (e.g., ventilation) of the residents, reflecting the areas identified to induce substantial energy savings (Dietz et al., 2009).

Residential energy consumption is, aside from technical parameters, determined by human behaviour (Haas et al., 1998). The traditional approach of policy makers to foster resource conservation relies on a rational model of human behaviour and is based on pricing mechanisms or regulations (e.g., subsidies for home retrofitting, phase-out of incandescent light bulbs). However, these kind of interventions are likely to face political resistance, their implementation is often slow and costly and fails to produce positive effects (Dietz et al., 2009). Contrasting the traditional approach, instruments influenced by the behaviourist paradigm have shown to be powerful and instantly available means to curb energy consumption (Allcott, 2011). Behavioural instruments take into account that human behaviour is determined by the complex interplay of intrinsic (e.g., interest), and extrinsic (e.g. external rewards) motives (Deci and Ryan, 1985) and often not fully bound to a logic rational. Additionally, there is strong evidence that the effectiveness of programs increases with the degree the content is tailored to the characteristics and possibilities of the participants, as well as the frequency participants interact with the content provided (Abrahamse et al., 2007). In this context, information systems (IS) for behavioural control (e.g., online platforms) yield the unique opportunity to enable the instant access to household-specific information on consumption, saving potentials, and context information that, for example, include social norms, to deliver personalized guidance's that aid the decision making process or change habits, and also to bring forth the implementation of behavioural mechanisms to motivate the voluntary interaction with the system. IS scholars have successfully incorporated findings from behavioural sciences and implemented scalable and cost-efficient solutions to control domestic energy consumption, like consumption feedback (e.g., social normative feedback) and goal-setting campaigns (Loock et al., 2011; Loock et al., 2013; Asensio and Delmas, 2015). Thus, campaigns need to incorporate behavioural instruments to increase the voluntary interaction with the tailored behavioural instruments.

The potential of IS to promote environmental sustainability through enabling and motivating sustainable practices, has recently gained much interest in the research stream often labelled as *green IS* (Watson et al., 2010; Melville, 2010; Seidel et al., 2013; Dedrick, 2010). Besides targeting the organizational level of analysis, *green IS* focuses on raising environmental awareness and encourage everyday life practices as well as ecological choices by single consumers. The utilization of information systems as low-cost and high-scale means of mass-communication to motivate sustainable behaviour on the level of single individuals has led to promising results, as a significant reduction in energy consumption (Tiefenbeck et al., 2015). However, research into IS based interventions to control domestic energy consumption and the implementation of behavioural instruments is still in its early stages. More research is needed to advance our understanding of how IT artefacts need to be designed in order to motivate residents to adopt the technology and consequently achieve positive effects (Loock et al., 2013; Watson et al., 2010). Specifically, a good understanding of how system and information characteristics shape the usage of the system is crucial.

Besides software engineering and technology acceptance, incentive alignment is considered to be the third dimension in the design and evaluation of IS (Ba et al., 2001). Regarding sustainable behaviour by individual consumers such as reducing their energy consumption, the aspect of incentive alignment becomes directly visible, as it is associated with financial and ecological benefits/ incentives for the consumer (Wunderlich et al., 2013). In the context of the theoretical foundation of human motivation, a significant body of research in the behavioural sciences has studied incentives to promote target behaviours. Yet, with rather inconsistent findings in the domain of energy, the implementation of incentive schemes seems to be a useful approach to establish good habits (Gneezy et al., 2011). However, the literature also points to potential unwanted effects of using external incentives in the long term, and after the intervention has ended, leading to below baseline frequency of the targeted behaviour (Deci et al., 1999). One explanation is that the external incentives undermine the intrinsic motivation to voluntarily perform the incentivized behaviour. Deci and Ryan (1985) explain this undermining on the basis of cognitive evaluation theory (CET) with the desired need for autonomy that is threatened ones external incentives control the behaviour (Deci and Ryan, 1985). Potentially, the undermining strongly depends on the type of incentive (e.g., monetary vs. non-monetary) as it frames the outcome of the target behaviour as either a monetary trade or a social event and the respective height of the incentives in place (Heyman and Ariely, 2004). This leads us to pursue the following research question:

How do the type and size of external incentives designed to support IS mediated sustainability programmes affect user engagement and energy savings?

The paper at hand empirically investigates the effect of different incentive types on the usage behaviour of an IS-based program to curb residential energy consumption and the effect of system usage on actual electricity consumption. For this purpose, we developed a web portal that was available for a randomly drawn subset of 20,000 customers of a utility company and conducted a large-scale field-experiment that involved 2,355 participants over the course of six months. Following a manipulation check, we analysed the effect of incentive type and size on system usage and finally the participant's energy consumption. Our research contributes to the research in IS, psychology, and the design of demand response programs to control domestic energy consumption.

2 Theoretical background and related work

2.1 IS to control residential energy consumption

The potential to employ scalable information systems to curb energy consumption has recently gained much interest in practice as well as in research (Flüchter and Wortmann, 2014; Loock et al., 2011; Loock et al., 2013; Watson et al., 2010; Wunderlich et al., 2013). In the context of *green IS,* the main body of research focuses on the organizational level of analysis and the potential contribution of IS to support sustainable practices across the entire firm. However, research in *green IS* not only recognizes the direct ecological impact of IT infrastructure production and usage but also second-order effects like the impact of information and communication technologies on industrial processes, and third-order effects like a change of lifestyle and economic structures (Wunderlich et al., 2013)

More recently, IS researchers have acknowledged the fact that individuals play a big role in the realization of the ambitious goals of energy transition and prevention of climate change (Watson et al., 2010). Loock et al. (2013) could show that the implementation of psychological concepts into the design of such studies could enhance their overall effectiveness. Concretely, in a field study the authors showed that nudging people to commit to a more challenging saving goal could increase savings by up to 2.3%. In a field-study, investigating the impact of an IS-enabled social normative feedback intervention to motivate ecological travel choices, Flüchter and Wortmann (2014) could show that in the short run the intervention yielded the desired effect. However, introducing a competition as an external motivator to a subgroup of the participants resulted in negatively affecting the intrinsic motivation of those participants and thereby negatively affecting the target behaviour in the end.

Similarly, studies estimating the effectiveness of a smart meter rollout in Europe show savings of 0.5% to 5% with the effect size depending on the user-technology interaction (Baeriswyl et al., 2012; Ernst & Young, 2013) and sample size (small samples appear to be biased towards higher intrinsic motivation and technology affinity) (Delmas et al., 2013). In addition, a decline in usage frequency, which is a common phenomenon observed in the first pilot studies, seems to be associated with lower energy savings. Incentive systems to use the portal can effectively motivate continuous system usage (Kollmann and Moser, 2014). Thus, incentivizing actual user engagement to support the positive outcomes of a green IS seems like a promising approach. However, it is still an open question of how IT artefacts have to be designed in order to achieve the desired engagement and motivate long-term system usage.

2.2 Motivation and incentive alignment in IS research

Ba et al. (2001) introduced the concept of incentive alignment as a third dimension in the design and evaluation of IS, besides software engineering and technology acceptance. The authors define incentive alignment as supporting organizational goals by reinforcing to "[…] employ the system in a manner consistent with the design objective […]" (Ba et al. 2001, p.226). Concretely, incentives influence the user's behaviour and interaction with the system in a goal directed manner.

In IS research on gamification, incentives have been used to "gamify" a system and show their potential to effectively engage users with application content, or increase productivity (see Schlagenhaufer and Amberg, 2015 for review). Incentives are most commonly operationalized in form of bonus points to steer the users' interaction towards the design objective of the system and, by showing progress and intermediate goals, motivate further interactions. In the context of gamification, intermediate goals and rewards are commonly represented as badges (Hamari, 2015). Badges offer users an informational component of why a certain behaviour can be beneficial and are commonly designed as optional rewards outside of the core functionalities of an IS. They can influence psychological as well as behavioural outcomes. However, only a few studies have so far shown the effectiveness of bonus point systems and badges in increasing intended user interactions, but first results are promising. Using game elements like bonus points Barata et al. (2013) for example could show an increase in the attention to reference materials, online participation and proactivity in an educational course and Costa et al. (2013) could increase punctuality in the workspace. Hamari (2015) could show an increase in various use-related metrics by gamifying a utilitarian trading system by the implementation of badges. Therefore, we propose that for users incentivized with bonus points the activity, and more specifically the goal directed interaction with the application content the points are given for, will be higher compared to when no bonus points are in place.

- Hypothesis 1: Bonus points increase the users' interaction with the application content

In the case of green information systems that help individuals to reduce their energy consumption, the consequences of using these systems are twofold. On one hand, a reduction of consumption or consumption in off-peak times offers a financial incentive in form of direct monetary benefits: People save money. Moreover, following policy regulations, incentives are becoming a mean to additionally motivate energy savings (e.g., an energy saving bonus deployed by a utility). On the other hand, by saving energy people contribute to environmental sustainability, and thereby potentially pursue their intrinsic need to act upon a problem they are increasingly aware of. Thus, inherent motivations to use systems that encourage consumers to save energy are not solely captured by external incentives but strongly depend on internal motives of the consumers. Furthermore, external incentives and internal motives are not only conceptually different but likely to interact.

Behavioural concepts from social psychology and behavioural economics draw a more complex and accurate picture of the motivational processes of technology adoption and usage, as increasingly recognized by IS scholars (e.g., Venkatesh et al., 2003; Wunderlich et al., 2013). One concept that has drawn much attention in the field of IS, is that of intrinsic and extrinsic motivation. Intrinsically motivated behaviour is performed by itself, in order to experience pleasure and satisfaction inherent in the activity (Vallerand, 1997; Deci and Ryan, 1985). Contrastingly, extrinsic motivation refers to performing a behaviour due to a separable outcome (Ryan and Deci, 2000). IS research commonly operationalizes intrinsic motivation as perceived enjoyment or playfulness and extrinsic motivation as perceived usefulness (Gerow et al., 2013). Davis, Bagozzi and Warshaw (1992) emphasizes the need for more research in order to understand the mutually reinforcing or countervailing effects of extrinsic and intrinsic incentives. However, the sources of and interplay between intrinsic and extrinsic motivation has yet not been a particular focus of research in IS (Gerow et al., 2013). Game mechanics, such as badges, can enforce not only extrinsic but as well as intrinsic motives, depending whether obtaining a badge involves challenges and informational elements (Malone, 1981). Behavioural research further suggests that the type of the reward associated with obtaining a badge also strongly determines whether it enforces extrinsic or intrinsic motives (Heyman and Ariely, 2004). Therefore, recalling Melvilles (2010) call to investigate what design approaches are effective for developing information systems that influence human actions about the natural environment and focussing on the dimension of incentive alignment, an understanding of the role of incentives in influencing user behaviour is crucial.

2.3 Motivation and incentive alignment in behavioural research

In general, incentives have two kinds of effects: The rational change of the outcome of incentivized behaviour, and somewhat irrational, psychological effects as for example on intrinsic motivation. The literature provides rather unstable results of interventions utilizing incentives to motivate sustainable behaviour and often points to the temporal dependency of effects (Abrahamse et al., 2007). Dietz (2010) describes the ineffectiveness of financial incentives to motivate cost-minimizing behaviour as the energy efficiency gap. In the field of energy, most interventions incentivize actual energy savings rather than concrete actions and decisions that directly or indirectly contribute to the superior goal of saving energy.

Other domains implemented incentive schemes yielding stronger positive effects over time. Incentives seem to be a potentially effective instrument to motivate people to exercise more frequently (Charness and Gneezy, 2009), to support compliance in psychotherapeutically interventions (Volpp et al., 2009; Budney et al., 2006), and, in general, to establish good habits (Gneezy et al., 2011). However, the success of interventions, and even the direction of effects thereby depends on the consideration of several psychological factors. Before engaging in a behaviour, incentives can change the individual’s perception of the task as either intrinsically or extrinsically motivated (Deci et al., 1999). Engaging in a behaviour, incentives can change the amount of effort we spend (Heyman and Ariely, 2004). Finally, incentives, especially when removed, can influence the likelihood to continuously engage in the incentivized behaviour (Deci et al., 1999). Thereby, effects seem to strongly depend on the type and size of incentives (Heyman and Ariely, 2004). Recent findings in the field of IS support these findings (Lounis et al., 2014).

Incentives can be monetary or non-monetary (e.g., symbolic) (Deci et al., 1999) and substantially vary in height. Following Heyman and Ariely (2004), the effort to reach monetary goals linearly depend on the height of the incentive provided. Thus, with monetary incentives in place, activity of users will depend on the height of incentives. In the context of green IS, non-monetary or intrinsic goals, such as the achievement to become more sustainable, can be represented more clearly by design and richness of information. As for example the achievement of mastering a level in a game can be perceived as differently valuable, we argue that effort to pursue the goals of the system as well increase with the perceived height of the incentive.

- Hypothesis 2: The activity of users will increase with the height of incentives

As a core proposition of Goal Contents Theory (GCT) of SDT Vansteenkiste et al. (2006) point to the dependence of incentives type on the kind of motivation underlying the goal of engaging in a task. Monetary oriented goals can be classified as extrinsic goals leading to extrinsic motivation. Achievement to learn or succeed can be classified as intrinsic goals leading to intrinsic motivation. As extrinsic motivation is known to crowd out intrinsic motivation (Deci et al., 1999) we argue that non-monetary incentives can be as effective in increasing the usage of an personal IS, as the interaction with the application content (activity) is usually characterized by multiple interactions over time. Based on the combined view of research in IS and psychology, we propose the following hypothesis:

- Hypothesis 3: The positive effect of financial incentives on the user activity can be reached with virtual incentives

Building on the overall design objective of the system, we further argue that there is a relationship between the active use of the IS and the target outcome that is energy savings.

- Hypothesis 4: Energy savings increase with the users activity on the portal

3 Field Study

3.1 Subjects and Design

Two thousand three hundred and fifty five real energy customers of a Swiss utility company participated in this field study. The study contained a 2*2 factorial between subject design (bonus type*bonus height), and a control group with no treatment. Participants in the treatment groups could collect bonus points for activity on the portal, participants in the control group received no bonus points at all. The points indicated the effect of the users choices (Zichermann and Cunningham, 2011). Depending on the experimental variation of the bonus type, the bonus points had a different purpose. We manipulated the bonus type and either used a monetary or virtual bonus to incentivize system usage. Participants in the monetary bonus group could redeem their bonus points for a credit on their invoice by their utility company. Participants in the virtual bonus group ascended levels to display progression and received badges as visual representation for the accomplishment for each level (Lounis et al., 2014). To manipulate bonus height, we implemented two levels for each bonus type. The financial bonus was implemented in a maximum of 25 CHF (23 € or USD 25), and 75 CHF (69 € or USD 75) to be earned within the six month of activity, respectively. The height of the virtual bonus was varied by tangibilizing the visual representation of accomplishments: Users could print “efficiency certificates” for each level. The participants were randomly assigned to one of the experiment groups at time of registration. The probability to be assigned to control group was set to one third of all the other groups as the utility requested more participants to be in one of the groups with incentives in place. Table 1 shows the experimental design and number of participants for each experimental group. In the user group 34% of the subjects were females.

Incentive type	Incentive Height	
	Low	High
Virtual	516 (Figure 2 a)	538 (Figure 2 b)
Financial	549 (Figure 2 c)	555 (Figure 2 d)
Control	197	

Table 1 Experimental design and number of participants

3.2 Procedure

In order to test our hypothesis, we developed an energy efficiency platform called “smartsteps” in corporation with a Swiss utility company that has around 250,000 residential energy customers. The underlying rationale for building the system was to create a behavioural intervention that uses IS to cost-effectively address a large number of people and that is capable of providing users with different kinds of incentives to rigorously evaluate their effectiveness on system usage. To promote the portal, the utility company sent out a direct mailing to 20,000 customers resulting in 2,355 signups since November 20th 2014 (11.78% signup-rate).

The web portal was designed to motivate users to save energy by providing energy consumption feedback on the users’ electricity consumption, information on in-home energy consumption in German language (energy quizzes, knowledge sharing), and energy saving tips. smartsteps served as the basis for an energy efficiency campaign that aimed at raising awareness about energy consumption and at preparing customers for the introduction of smart meters. The platform was based on the design of platforms successfully used to conduct large scale field-experiments (Loock et al., 2011; Loock et al., 2013). The experience chain is depicted in Figure 1.

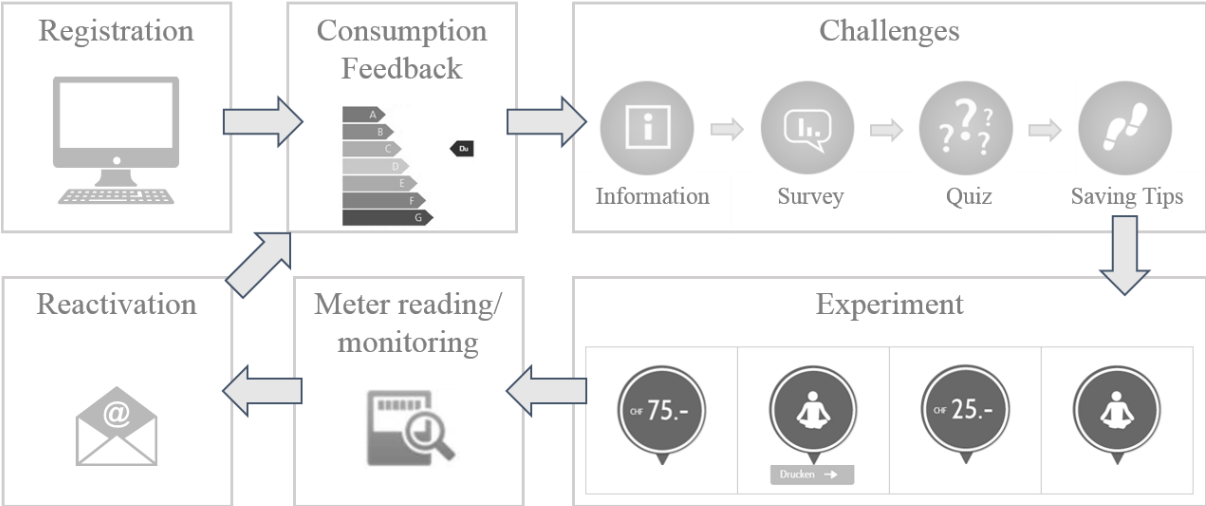

Figure 1 Experience chain of smartsteps

smartsteps enables users to check their households energy efficiency, on the basis of self-entered household details and their yearly electricity consumption which is stored in the backend of the system. Additionally, users can monitor their electricity consumption by entering their meter information, and engage in *challenges* that contained information and saving tips to decrease their in-home energy consumption. After registration, users could enter their household details and received an injunctive (in form of a rating on an energy efficiency scale) consumption feedback that was calculated based on their electricity consumption (Loock et al., 2011). Afterwards, users were guided to take their first *challenge*. *Challenges* are blocks of content elements and consisted of information elements, surveys, quiz questions, and saving tips. The information gave a reference frame to each challenge and set general goals for the user (Passos et al., 2011). Surveys and quizzes were used to assess household characteristics, and knowledge levels, respectively. The information was used to select useful saving tips for each user. Six new *challenges* became available over the time course of six month. All participants of the study had equal access to the content and were presented the same content elements.

The content elements of the platform were designed to be challenging for users. Past research showed, that entering a meter reading on the platform and the execution of saving tips is no behaviour voluntarily done by a large portion of the population. Thus, incentives are effective means to increase activity, as activity is generally low (Graml et al., 2011). For all content elements, users could collect bonus points. Participants in the control group could not collect any bonus points. The incentive scheme is listed in Table 2.

Content element	**Availability/ Month**	**Bonus Points**
Injunctive consumption feedback	Once	20
Normative consumption feedback	Once	20
Correctly answered quiz question	4	3
Co-creation	1	10
Saving tip (promised/ done or comment)	3	20
Meter reading	4	10
Meter reading reminder	Once	20
Load disaggregation tool	Once	20

Table 2 Incentive scheme

Upon registration, participants were assigned to different groups. Based on the group participants either received a high financial, a high virtual, a low financial, or a low virtual bonus they could redeem/ received for their points, or no bonus at all (control group). Participants could enter their own meter readings to monitor their electricity consumption on a weekly basis, and set an email reminder. Each time new content became available, users received a notification via email. At the second login, users could receive a social normative consumption feedback comparing their electricity consumption to that of their neighbours.

To maintain control over the online portal, members of our research team programmed the entire system. One day after signing up on the portal, participants were invited to take a short survey to assess the perceived height of the incentive. The activity of the participants was defined as the interaction with incentivized content elements. As the goal of the portal was to motivate a large number of participants to be as active as possible, the activity was assessed as the logarithm of bonus points collected to account for few extremely active users and the associated right-skewed distribution. To track the participants' change in the trend of their electricity consumption after signup on the portal we received consumption data by our utility partner and collected self-entered meter readings by the participants.

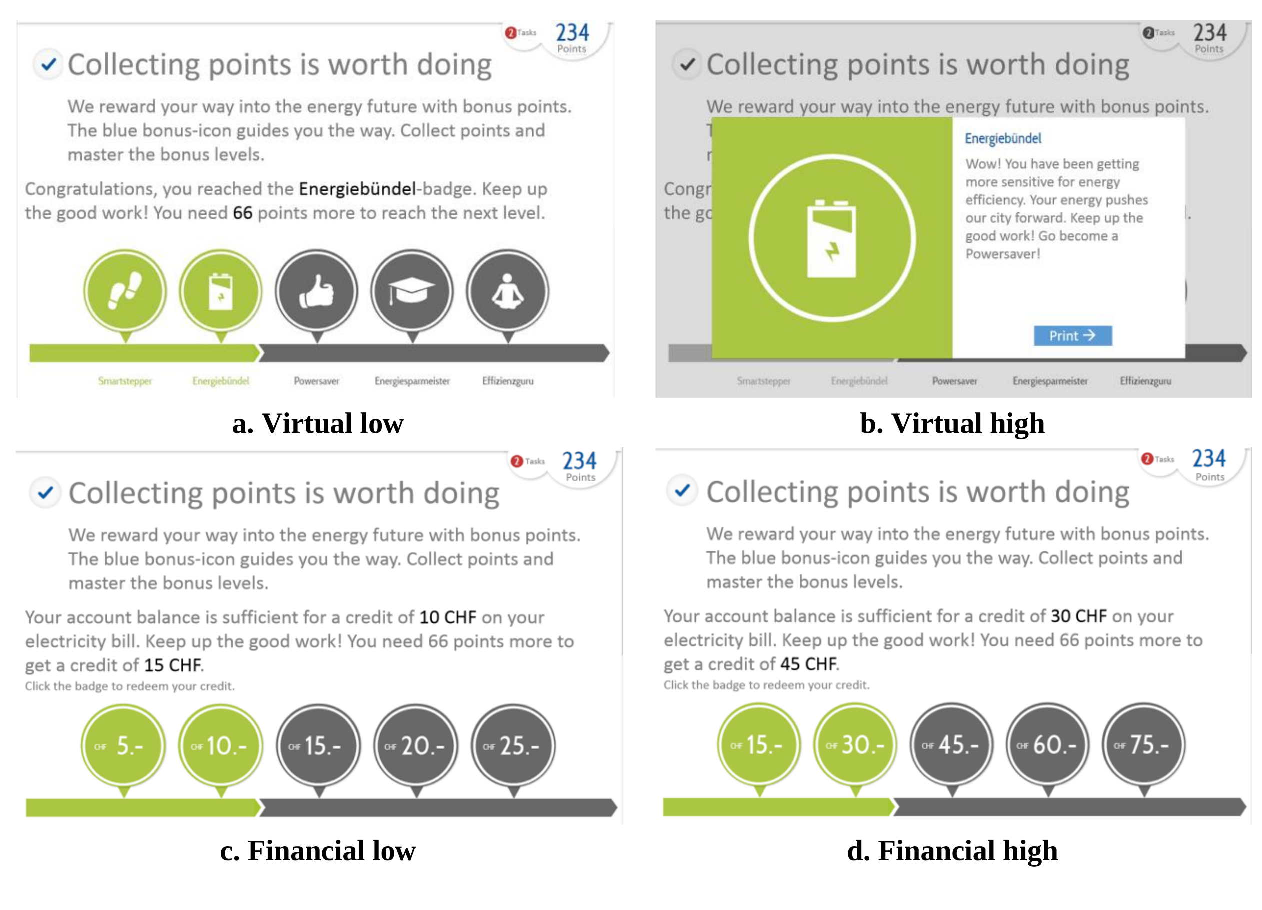

Figure 2 Experimental stimuli displaying the different incentive types, and heights

3.3 Intervention

The goal of the content items provided was to increase the energy awareness of the participants and motivate an individual reduction of energy consumption. Bonus points and the associated incentives aimed to influence the behaviour of the participants towards this goal (Ba et al., 2001). Concretely the incentives were designed to reinforce the interaction with the content elements and thereby increase the overall activity of the participants. Bonus points were shown on each content item to indicate the value of the interaction with this item. The collected bonus points were displayed on a separate page. The control group could not see either the points on the content items or the separate page. The bonus points accumulated over time and "unlocked" the respective bonus.

Each group had to collect 100 points per bonus stage (e.g., 100 points for a credit of 15 Swiss francs (equal to 13 € or USD 15) for the bonus group financial high). The last stage of bonus points was reached at 500 points. The risk of participants manipulating the system was prevented by the limited amount of points one could collect. As listed in Table 2, participants at least had to be active for 3 month to reach the last bonus level but could reach the first level within the first experience chain. The experimental stimuli used to represent the respective incentives are displayed in Figure 2.

4 Analysis and results

To assess whether the different incentive types and heights were, besides their objective difference, perceived differently, we measured the perceived value of the separate incentives following the methodology proposed by Okada (2005). The perceived value of the bonus as a function of bonus group is displayed in Figure 3. An ANOVA shows that there is a highly significant effect of bonus type on the perceived value; $F(4,82) = 6.85$, $p < .01$, and a weakly significant effect of bonus height on the perceived bonus value; $F(4,82) = 2.53$, $p < .10$. The interaction of incentive height and type showed not to be significant; $F(4,82) = 0.07$, $p = 0.78$. Thus, the manipulation of incentive height and type also had an effect on the perceived value. The direction of the effect is – as expected – in direction of the intended manipulation, which is therefore successful.

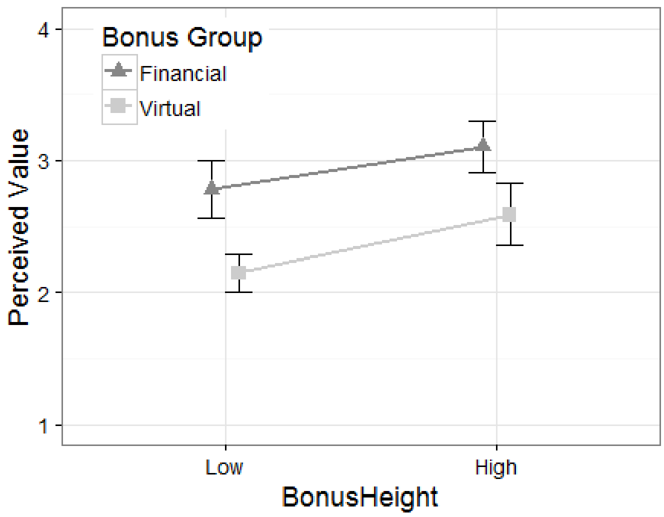

Figure 3 Perceived value of the incentives by bonus group; error bars indicate the standard error of the mean.

As shown in Figure 4, the results supported not all assumptions stated in hypothesis 1 to 3 but revealed rather counter-intuitive effects. As predicted in Hypothesis 1, incentives increased the users' activity on the portal, compared to when no incentives were in place ($F(4,2350) = 4.36$, $p < .01$). For further analysis of single group differences, all analyses were carried out as planned contrasts within analysis of variance, as standard factorial design was not used. Hypothesis 2 was not supported for financial incentives, as the activity of the high financial and the low financial bonus group did not significantly differ ($t(4,2349) = 0.424$, $p > .6$), even though the perceived value increased with incentive height.

However, as predicted in Hypothesis 2, the activity of the participants given the virtual incentive increased when the bonus height increased from low to high (t(4,2350) = 1.715, p < .1), in line with the perceived value of the incentive. Therefore, results indicate that the relationship between bonus height and activity is not equal for incentive types (at least in the height under investigation) but interacts. Hypothesis 3 is supported as the high virtual incentive increased activity to a level that it does not differ to that of both financial incentive groups (t(4,2350) = 1.502, p > .1).

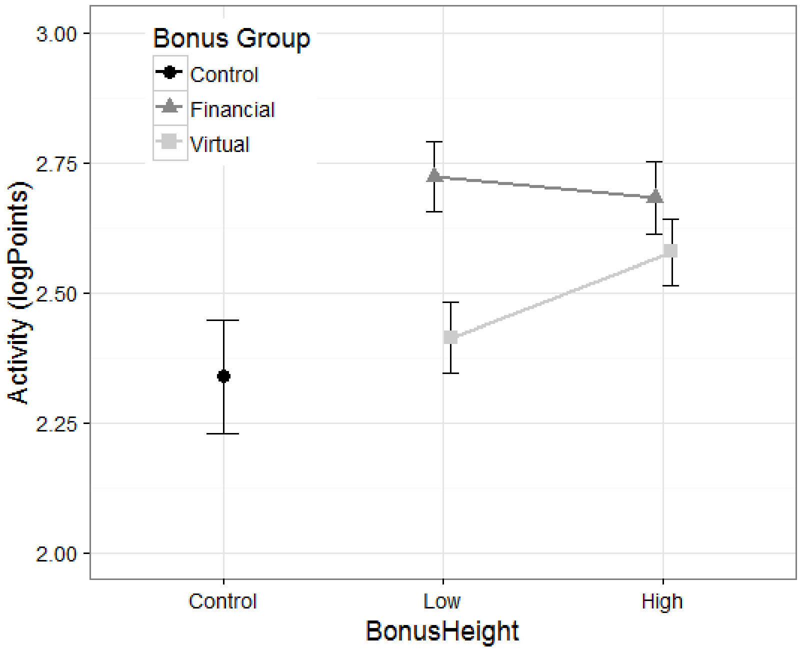

Figure 4 *Average activity as a function of incentive type and height. Error bars indicate the standard error of the mean.*

Finally, to test hypothesis 4, we checked whether the activity on the portal has a positive effect on electricity consumption that is a reduction of consumption. Table 3 shows the descriptive statistics for the participants' electricity consumption before and after intervention start (defined as day of signup). Data was assessed on basis of yearly meter readings and self-entered readings by participants. To calculate the consumption before the signup at least two meter readings are necessary. It was not possible to determine whether the reduction came from the signup or other influences due to the following factors:

- The temperature as the one of the largest influences on energy consumption was different in the years before and after the campaign.
- The consumption of portal participants differs strongly from that of the customers who did not opt-in. The magnitude of consumption and therefore also the savings are much higher for the participants.
- The (yearly) meter reading of all customers happen at different points during the year. The selection bias is alleviated by considering the meter readings for at least a year before and after the campaign start.

Hypothesis 4 is supported as the activity on the portal is associated with the reduction of participant's electricity consumption as shown in the results of the linear model in Table 4. However, effects are quite small. For users, the mean difference that is described by activity is -2.19%. That is the users collected 2.6 LogPoints on average leading to a reduction of 2.19% based on the model and an average reduction of 34 kWh/ year.

	Mean	SD	N
Cons. before signup	7.34	3.91	1,757
Cons. after signup	7.16	3.91	1,757

Table 3 *Mean electricity consumption of participants before and after signup. Consumption is displayed as average consumption in kWh per day. Data was available only for a subset of 1,757 participants.*

	Estimate	Std. Error	Pr(>|t|)
Intercept	- 0.08195	0.04854	0.0915 .
Activity (LogPoints)	- 0.03559	0.01614	0.0276 *
Signif. codes: 0.01 '*' 0.05 '.' 0.1, Multiple R-squared: 0.002762			

Table 4 *Effect of activity on change in electricity consumption.*

5 Discussion

5.1 Key findings

In this paper, we described the concept and implementation of an information system to motivate sustainable behaviour in end consumers. Specifically, we developed a web-portal that aimed to curb energy consumption of customers of a utility company by providing household-specific information on consumption, context information like social normative feedback and personalized support in making sustainable decisions and change existing habits. The portal was accessible to a subset of 20,000 customers of the utility from November 2014 and had 2,355 users. We used the platform to test the effect of different incentives on activity on the portal and energy savings. Therefore, participants were randomly assigned to an experiment group upon signup that varied the type (monetary vs. non-monetary) and height (high vs. low) of the incentives and a control group that did not receive any incentive, respectively. We found that incentives increased the activity of participants on the portal, but that effects depend on incentive type and height. Surprisingly, the activity did not increase with the height of the financial incentive but with the height of the non-monetary, virtual incentive. Additionally, a high virtual incentive (with which no costs were associated) showed to be equally effective in increasing activity compared to both high and low financial incentives. As hypothesized, a portion of the reduction of participants' energy consumption after intervention start was explained by the activity on the portal.

5.2 Implications for theory and practice

Our results are valuable for both, practitioners and researchers. We used a sample of real energy customers that used a service portal provided by their utility, enabling us to yield results with high external validity. We could show that incentives increase the activity on a web portal to motivate sustainable behaviour but that the effectiveness of monetary incentives is not necessarily superior to non-monetary or virtual incentives. Therefore, the assumption of a user's behaviour to be linearly dependent on the expected outcome of his actions does not hold up. Solely providing users of green information systems with higher monetary incentives does not necessarily increase their activity and thereby associated positive outcomes. Furthermore, designing incentives that appeal to the intrinsic motives of the user and at the same time being perceived as valuable, can increase user activity to the same effect as financial incentives – with no associated monetary costs for the provider or potentially harmful effects like the crowding out of intrinsic motivation.

Besides fulfilling intrinsically motivated goals, saving energy always holds financial benefits, as households save money. Nonetheless, we could show that green IS targeting individual households can benefit from emphasizing other aspects of a program than monetary consequences. This is in accordance with latest findings emphasizing the opportunity of virtual rewards or badges to appeal to intrinsic motives that have shown to be more powerful predictors to engage in an activity, especially long-term (Hamari, 2015; Malone, 1981), and research investigating nonprice incentives and energy conservation (Asensio and Delmas, 2015).

Contrasting established theory, the activity of participants did not increase with the height of financial incentives but with the height of virtual rewards (Heyman and Ariely, 2004). This is likely due to the different properties of the high and low virtual rewards in place. As low rewards simply signal progress and a level of achievement, high virtual rewards inherent a higher informational component and come from an official and trusted sender, both known factors in increasing intrinsic motivation and the participation in programs to reduce energy consumption in general (Deci et al., 1999; Hoicka et al., 2014). Thus, in the context of IS, established theory might not hold and needs to be adjusted. The outcome of a green IS targeting households (e.g., energy savings) has shown to depend on the active usage of the system over time. Intrinsic motives thus play an important role as they better predict long-term behaviours, than external incentives, which also in turn negatively affect intrinsic motives.

Additionally, the activity of the participants on the portal showed to be associated with the change of participant’s electricity consumption after signing up. The mean difference in electricity consumption that is described by activity is -2.19%, which shows that active users have a higher reduction in energy consumption. For the field of green IS, this emphasizes the need for interventions targeting everyday behaviours and habits of single individuals to maximize interaction points with the system provided.

5.3 Limitations and future research

In the present study, the effect of monetary incentives on the activity of the participants is solely accountable in the heights under investigation. The incentive of 75 CHF (69€ or USD 75) was not sufficient to further increase activity compared to 25 CHF (23€ or USD 25), but higher incentives may be. When assessing the impact of the intervention, a group specific and overall evaluation of energy savings would be beneficial. At the time of writing the paper, the data only allowed for the evaluation of a general association of activity and energy consumption. As the available data will increase over the course of the next month this evaluation will be logical next step.

Our design required an opt-in by participants: After being contacted, participants had to go on the web portal and sign up for participation. The response rate of users in our campaign was reasonably high with a level of 11.78%, however a system with an opt-out design could obviously further increase the reach of the system (e.g., monetary bonus for energy savings). In this context, the alignment of incentives and particularly the type of incentives may, even to a larger degree than in an opt-in setting, influence user behaviour, as people do not voluntarily choose to pursue the incentives.

Our research considered separately the influence of incentives on the portal participation and the effect of the participation on energy savings. The direct influence of the different incentives types on the energy consumption would be a next step. It was not performed in this study due to the large number of participants for which not enough meter readings were available or who used the portal only limited number of times.

Further research could investigate the effects of incentive type and size on constructs determining the adaption and continuous usage of technology, such as those reflected in the technology acceptance model (Venkatesh et al., 2003) and the internal and external perceived locus of causality (Wunderlich et al., 2013). This would allow for a deeper understanding of the processes elicited by different types and heights of incentives. Finally, the investigation of design-dimensions of the perceived value of incentives could allow practitioners to optimize incentive alignment for the purpose of the system.

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Appendix:

Bonus Group	**n**	**mean Activity (LogBonus Points)**	**SD**
Control Group	197	2.34	1.52
High financial incentive	555	2.68	1.66
High virtual incentive	538	2.59	1.48
Low financial incentive	549	2.72	1.58
Low virtual incentive	516	2.41	1.55

Table 5 Descriptive statistics for activity as a function of incentive type and height. User activity is measured as the logarithm of bonus points collected. Scale ranges from 0 to 6.6.

What is the value of the bonus points?	*Not at all valuable/ extremely valuable*
How well off are you with the bonus points?	*Not at all well off/ extremely well off*
How happy are you with the bonus points?	*I do not care about it at all/ I am very happy*

Table 6 Okada Scale to assess perceived value of incentives (measure on five point likert scale, alpha= .91):

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