IN-HOME DISPLAYS AT HOUSEHOLD CUSTOMERS. RESULTS FROM A NORWEGIAN PILOT STUDY.

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ABSTRACT

This paper presents the result of a pilot test where in-home displays were tested among 91 households in Norway. The test group was compared to a control group of 42 households. The main objective was to test if the customers would reduce their electricity consumption due to updated feedback regarding their own consumption, and their presumed changed attitude towards electricity as a product. Three surveys were performed during the test period.

INTRODUCTION

EU has introduced binding targets to reduce greenhouse gas (GHG) emissions by 20 %, ensure 20 % of renewable energy sources in the EU energy mix and reduce the EU global primary energy use by 20 % by 2020. These targets have led to increased focus on energy consumption of final customers.

Most domestic use of electricity is invisible to the user. Giving feedback to final customers about their energy consumption can lead to greater awareness about their energy use and potential energy savings for the customers.

In [1] and [2] studies with direct feedback, indirect feedback and feedback with time of use pricing are listed and study characteristics and results are summarised. In [1] it is indicated that the savings from direct feedback range from 5-15 %. A British study [3] explores customer preferences for in-home energy display functionality. Experiences and recommendations from these pilots and other research projects have been considered in the planning of the pilot described in this paper and the survey design.

RESEARCH PROJECT (METHOD)

The research project "Environmental benefits from full scale implementation of Smart Metering" (2009-2013) at SINTEF Energy Research is aimed to highlight potential environmental benefits related to the introduction of Smart metering.

The focus of the project is to:

1. contribute to increased efficiency of the data management related to full scale implementation of Smart Metering, and
2. achieve environmental benefits in terms of reduced energy and power demand by making the customers more conscious regarding their own consumption. It will be investigated to what extend customer awareness can be increased by using load control and in-home displays.

Pilot study

A pilot study was finalized in the end of 2012. The objective of the pilot study was to identify how to increase the customers' awareness regarding their own electricity consumption, and through this encourage them to reduce their consumption.

In the pilot study 91 in-home displays has been installed at household customers (47 located in Askøy – in the Western parts of Norway and 44 located in Follo – in the Eastern parts of Norway). The Norwegian in-home display "eWave" has been tested.

Three customer surveys have been performed during a one-year test period. The first survey was sent to the customers before the in-home display is installed, the second one about three months after the installation and the third one at the closure of the pilot study.

In addition two surveys have been performed at 42 households representing a control group.

In-home display "eWave"

The Norwegian in-home display "eWave1" has been tested in the pilot study. The in-home display has different display options (e.g. graphs or speedometer) to present both electricity consumption and energy costs.

1 www.ewave.no

Figure 1 eWave in-home display

The display has wireless communication with a pulse meter connected to the electricity meter. A smart meter was not used. The display is connected with internet via the WLAN of the houses.

It is possible to send messages to the customers via the in-home display including different options for customer information.

A first version of the display was tested in the pilot. Some technical problems were experienced, but these start-up problems were solved. A new version of the display will be released in 2013.

Customer surveys

In total, three surveys were performed during this pilot study. Some questions have been included in all the surveys to monitor and follow up changes in customer habits during the study. The customer surveys were web-based and the participants were contacted by e-mail. The answers are treated anonymously. The response rate for all the surveys are presented in Table 1.

Table 1 Response rate for the different surveys

Group	First	Second	Third
Askøy	95,7 %	66,0 %	56,5 %
Follo	77,0 %	63,6 %	40,9 %
Control	83,3 %	-	64,3 %

The response rate was decreasing during the pilot study, and that might be due to the technical problems the customers experienced with the displays.

The surveys contained questions concerning:

- Demographical data (Building type, size and age, Family size and age structure, Income, Heating device)
- Electricity consumption (Habits (appliances on/off), Attitudes (environment – economy), Energy savings, Meter-reading and energy bill)
- In-home display (Motivation for participation and expectations, Evaluation of the in-home display (design, user friendliness, etc.), Interesting functions, Frequency of use, Does the in-home display support changed focus regarding the use of electricity?)

Recruiting the household customers

The households participating in the pilot study are all customers of the power retailer Askøy Energi and Fredrikstad Energi. An announcement of the pilot study was presented in the local newspaper and the customers volunteered for participation. One criterion for participation was an annual electricity consumption of at least 20.000 kWh to be sure that the heat demand fully or partially is covered by electrical space heating. Electrical space heating stands for approx. 63% of the electricity consumption in Norwegian households [4] and a high saving potential is expected. In Follo a control group of 42 households were established.

The customers perform self-reading of their meter every second month. Smart Metering has not been installed during the test period.

Since the customers participate in this pilot study through self-selection, it can be expected that they are more than average interested in and conscious about their own electricity consumption.

RESULTS

Examples of results from each survey are presented in this section, together with some trend analyses. The trend analyses are based on questions that have been repeated for more than one survey.

First Survey – Before installation

Single family houses are the most common building type for both the test and the control groups. 114 households responded on the first survey, and in this group 85% lived in a single family house. Single family houses are also the most common building type in Norway, and on a national level 52.2 % has this type of building. The customers in the survey therefore deviate from the national statistics.

Average building year for the houses is relatively equal for all the different groups in the survey. Approx. 10% of the

houses are built before 1950, and approx. 50% are built after 1980. Compared to the national statistics the buildings in the survey are newer than the average in Norway, i.e. a smaller amount of houses are built before 1950 and a larger amount of houses are built after 1980.

The average number of persons per household is quite equal for all the groups (from 3.42 to 3.74), but this represents lager households than the average in Norway, which is 2.2 persons per household.

The households were asked about what type of information they were most interested in (See Figure 2). Real-time consumption was the information most of the households wanted, the second was information about the electricity costs. A larger part of the households in Follo was interested in historical data and monthly consumption, compared to the households in Askøy (74 % and 76 % vs. 51 % and 49 %).

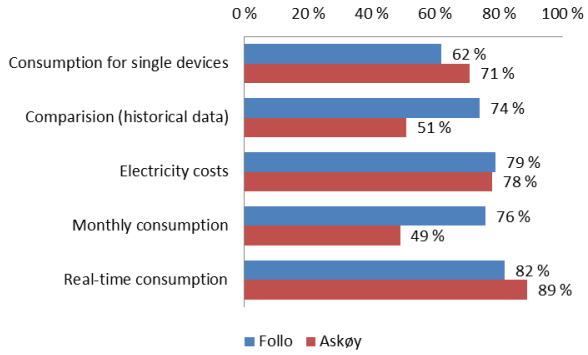

Figure 2 Type of information wanted

Second Survey – After three months

In the second survey the customers were asked about the influence of the display. The results are presented in Figure 3.

The households are positive to the display and confirm that this is not a disturbing factor in everyday life. 69 % *Totally disagree* or *Disagree* in the statement that the display is a disturbing factor during the day.

Additionally, 59 % *Agree* or *Totally Agree* that the display helps them to save electricity, 54 % *Agree* or *Totally Agree* that the display helps them to save money and 46 % *Agree* or *Totally Agree* that the display helps them making environmental considerations during the day.

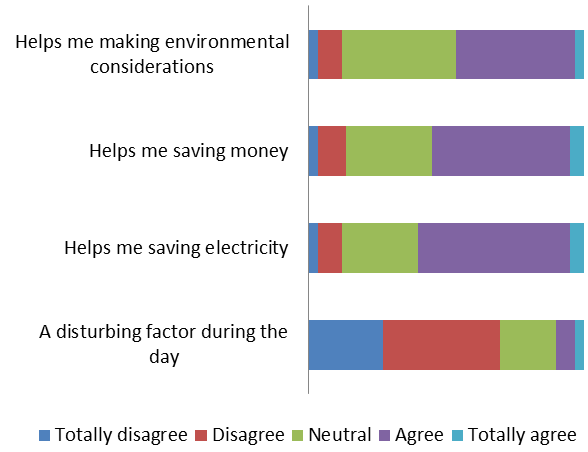

Figure 3 The influence of the display

Third Survey – After one year

In the third survey the households were asked about what they think about getting a smart meter with automatically meter reading (See Figure 4).

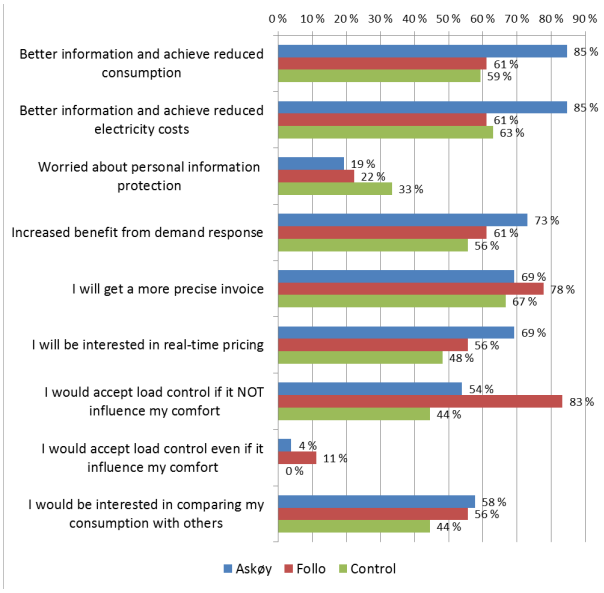

Figure 4 Attitude towards a smart meter

Most of the households were positive, and expected that increased and updated information about their electricity consumption would help them to achieve reduced consumption and reduced electricity costs. 19-33 % was worried about their personal information protection, but the main part where from the control group.

In average 61 % of the households would accept remote load control if this did not affect their comfort, but only 5 % (in average) would accept load control if this affected their comfort negatively.

Trend Analysis

In all the three surveys the households were asked about their habits related to electricity, such as reducing the indoor temperature, turning off appliances and lights (Figure 5).

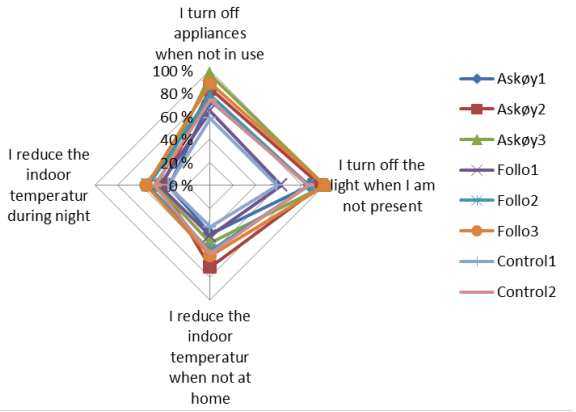

Figure 5 Habits concerning use of electricity

A larger part of the household turned off appliances and lights when not in use or if they where not present. In average from the whole survey 81 % turned off appliances and 88 % turned off the lights. The same habits for the control group were 66 % and 72 % respectively. A smaller part of the households reduced the indoor temperature, where in average 54 % reduced the temperature during the night and 46 % reduced the temperature when not at home. The same habits for the control group were 48 % and 42 % respectively.

DISCUSSION AND CONCLUDING REMARKS

This paper presents some results from the pilot study where in-home displays were tested out at 91 households for a period of one year. Three surveys have been performed during the study.

The households participating in the study volunteered. It can therefore be expected that they are more than average interested in and conscious about their own electricity consumption.

The households expected that information about their real-time consumption was the information that they were most interested in. In the survey performed after three months the households admitted that the display helped them saving both energy and money, and also making environmental considerations during their day. Only very few households responded that the display was a disturbing factor in their everyday life.

Smart meters will be deployed in Norway in the coming years, and due to this the households were asked about their opinion related to this. Most of the households expected that this would help them in saving energy and reduce their electricity costs. They would also accept remote load control if it does not have negative influence on their comfort.

During the whole survey the households were asked about habits related to the use of electricity (Figure 5). "Visible" actions such as turning off appliances and lights are common to do, but "invisible" actions such as reducing their indoor temperature are less common – even if the saving potential is larger for heating appliances than for lighting. (Electricity and wood-burning stove were the most common sources for space heating.) Information about the real-time consumption of electricity is therefore important to show the households the large amount of electricity used for space heating.

The results from this survey indicates that the households are interested in and capable of reducing their electricity consumption as long as they are informed about this – and also if they get incentives for doing so (for example real-time prices). Correct information is important to stimulate the households to change their habits and reduce their consumption.

Acknowledgments

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