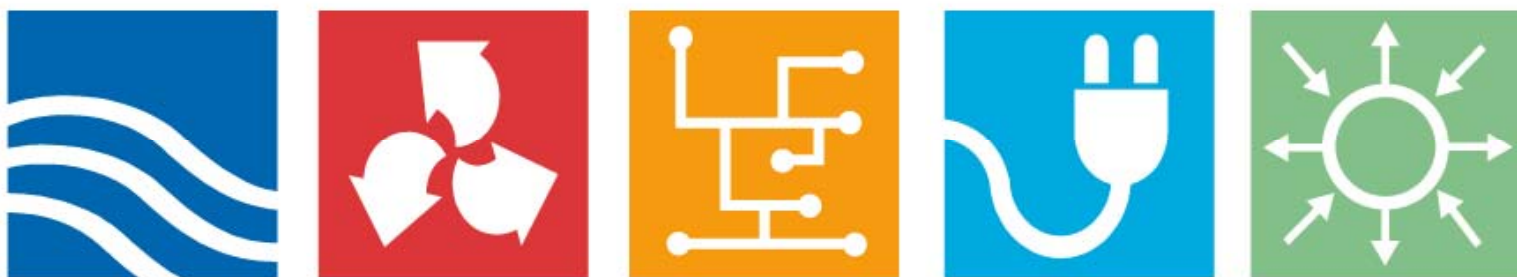




Presenting consumption graphically – the complete story

Elforsk report 07:44



Tim Hallin, Inger Lindstedt, Tove Svensson

August 2007

ELFORSK

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English by Global Text AB, Stockholm

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Preface

This literature survey is a contribution to the AMR Visualisation project, which is part of the ELAN programme Stage III. The project manager is Anders Göransson, Profu. The main author of the report is Tim Hallin, Media and communication studies, K3, Malmö University. A design proposal for the graphic presentation of consumption has been made by Tove Svensson, graphic designer, K3, Malmö University. The scientific leader and joint author is associate professor Inger Lindstedt, K3, Malmö University.



ELAN is a research program that works with the area of everyday electricity use. Activities are aimed at energy-related matters in the borderline between technology and peoples' use of technology:

- AMR – Remotely read electricity meters and Visualisation of electricity use
- Communication related to energy and everyday matters
- Energy related investment decisions and guiding factors
- Energy use in everyday life

The ELAN programme is financed by The Swedish Energy Agency, Alvesta Energi, Borlänge Energi, E.ON, Fortum, Göteborg Energi, Jämtkraft, Skellefteå Kraft, Umeå Energi, Varberg Energi, Vattenfall and Öresundskraft.

More information about the ELAN programme is available from www.elanprogram.nu.

Summary

The new Directive 2006/32/EC of the European Parliament and of the Council on Energy End-Use Efficiency and Energy Services demands that information relating to customers' use of energy is provided, for example, on invoices. How, then, should this information best be presented so that it is easy for customers to understand, experience as something positive, and at the same time help them to change and adapt their behaviour and habits?

In recent years several research projects have been undertaken with the aim of finding out how customers experience and perceive the visual information about energy usage that appears on their invoices.

The purpose of this overview is to summarise previously existing knowledge about how to present the invoice's visual information relating to energy use in a way that is experienced and understood by the customer as positive. Based on the results of this knowledge overview, the report concludes by providing inspiring examples, suggestions and outlines as to what form this might take.

This knowledge compilation is based on twenty reports and articles, all of which depart from specific purposes, methods, materials and results. Unfortunately, when it comes to the graphs used as examples and alternatives in the articles and reports, and which are also presented in this text, no motivation has been provided for their use. The graphs that have been used in this text must therefore be regarded as experiments and ad-hoc solutions.

The examples used in the articles and reports, and included in the overview, do not appear to contain anything that completely corresponds to the prerequisites considered necessary for good and effective feedback. This means that at present there is no obvious solution as to how energy use should be graphically presented.

Two different types of feedback can be applied that make full use of the information provided by electricity meters, namely,

- *Historical feedback*, which indicates the customer's present and past energy usage
- *Comparative feedback*, which shows the customer's energy use, for example, in relation to that of their neighbours.

The third feedback alternative, which at present cannot be directly ascertained from the information provided by the electricity meter but which can nevertheless be decisive to the discussion, is

- *Breakdown feedback*, which illustrates how the customer's energy use is distributed between various kinds of household appliances and other energy-intensive products.

In addition to these three feedback alternatives there is also a fourth communication-based alternative, which as a rule is not directly associated with the information provided by the electricity meter but which can nevertheless contribute to a better understanding of both the invoice and personal energy usage – primarily in combination with one of the three above-mentioned feedback alternatives. In this report the fourth alternative is referred to as

- *Advice related to energy and energy conservation.*

The points that follow are based on the knowledge overview and can be regarded as an aid to determining the direction of the continued work.

- A combination of different feedback alternatives is suggested. Historic feedback in combination with one or two of the other feedback forms and associated advice about energy and energy conservation ought to provide reasonably good results.
- The aspect of time is an important question in terms of the creation of historic feedback. Here a decision must be taken as to how far back in time the information should be both compared and apportioned. Although a monthly breakdown certainly provides the customer with a lot of facts and figures, the provision of an easily interpreted graph could help to minimise any resulting problems. Account must also be taken of the fact that customers can doubt or misinterpret information, particularly as weather conditions differ from year to year. At present there is no really good way of parrying this.
- When it comes to comparative feedback, goal-related feedback is perhaps the best option, since this allows the customer to relate personal use to their own household (the household that the customer can perhaps more easily accept when it comes to correct and acceptable comparisons). Goal-related feedback is based on the energy company setting goals for the customer to follow and thereby monitor their personal energy usage. This is a way of overcoming the problems that can occur in the creation of acceptable comparative groupings. This type of feedback is also very personal, which means that there is less risk that the feedback will only emphasise a change of behaviour and habits among high energy consumers.
- As break down feedback is currently not practicable through meter reading alone, this feedback alternative has not been very highly profiled. At the same time it ought to be borne in mind that this feedback alternative may give the best results – and in the long-term allow the customer to take account of break down feedback.
- Advice about energy and energy conservation should also be included and relate to the other feedback alternatives. The fact that no satisfactory solutions or factual examples of this have been included in the reports and articles accounted for in this text indicates that this section requires further work. Advice about energy and energy conservation must be experienced as something personal, and in some way or other relate to the feedback received by the customer.

Contents

1	Present consumption graphically – the complete story	7
2	To be born in mind...	9
3	Basic conditions for good feedback	10
4	Different types of communication	11
4.1	Historic feedback	11
4.1.1	Example 1	12
4.1.2	Example 2	13
4.1.3	Example 3	14
4.1.4	Example 4	15
4.1.5	Example 5	17
4.2	Comparative feedback	17
4.2.1	Example 6	18
4.2.2	Example 7	20
4.2.3	Example 8	21
4.2.4	Example 9	22
4.2.5	Example 10	22
4.3	Breakdown feedback	23
4.3.1	Example 11	24
4.3.2	Example 12	25
4.4	Advice on energy and energy saving	26
4.4.1	Example 13	26
4.4.2	Example 14	27
4.4.3	Examples 15 & 16	28
5	Concluding reflections	30
6	For further inspiration	32
6.1	Some older examples	33
6.2	Inspiration for presentation of consumption on invoices	35
7	References	40
8	Reports and articles included in the literature survey.	41
	APPENDIX: SUMMARIES OF REPORTS AND ARTICLES INCLUDED IN THE LITERATURE SURVEY.	43

1 Present consumption graphically – the complete story

The new Energy Services Directive adopted by the EU in April 2006 makes new demands on the information given to customers that relates to their energy consumption. It is necessary to achieve more efficient final use of energy and to direct demands for energy so that the goals in the Kyoto Protocol can be reached. The Directive says that:

In order to enable final consumers to make better informed decisions as regards their individual energy consumption, they should be provided with a reasonable amount of information thereon and with other relevant information, such as information on available energy efficiency improvement measures, comparative final consumer profiles or objective technical specifications for energy-using equipment, which may include 'Factor Four'¹ or similar equipment. [...]

All types of information relating to energy-efficiency should be widely disseminated in an appropriate form, including through billing, to relevant target audiences. This can include information on financial and legal frameworks, communication and promotion campaigns, and the widespread exchange of best practice at all levels

(Directive 2006/32/EC of the European Parliament and of the Council)

The new Energy Services Directive thus includes demands for information about their energy consumption to be included on bills to the consumer. How should this information be visually designed so that customers understand it, regard it in a positive light and in extension, also change their behaviour and habits on the basis of this knowledge?

Several research projects have been carried out in recent years, where the aim was to investigate how customers perceive and understand the visual information about energy consumption on their bills. The AMR Visualisation research project, within the framework of the ELAN program, is a sub-project which was aimed at the way that consumption is presented graphically on invoices. This sub-project has the assignment of compiling a literature survey.

The goal of this literature survey is to summarise the knowledge that already exists related to how visual information on invoices about consumption should be designed to be understood and perceived in a positive light by customers.

The literature survey is based on twenty reports and articles. A systematic review has been made of the goals, visual presentation, target group and results covered in the articles and reports. A summary of each report and article is included as an appendix to this report. Anybody who wants more information about each graph and survey can thus find more information in the appendix. If you want more information than is

¹ The expression "factor four" is originally an idea found in "Factor Four – Doubling Wealth, Halving Resource Use" by Ernst Ulrich von Weizsäcker, Amory and Hunter Lovins, 1995. The concept indicates that we should become four times more efficient in using energy (double the benefit and halve the use of resources).

provided by this report, please refer to the appropriate article or report. Literature references are also included in the appendix.

The goal of the summary is also to compile useful knowledge about visual communication in a directly accessible manner that can be put to practical use. For this reason, the report also contains a section that we have chosen to call *For further inspiration*. The purpose of this section is to show good examples that can provide inspiration for developing visual communication. It also includes a number of good, historic examples of visual communication, and also ideas, sketches and suggestions prepared by Tove Svensson, graphic designer, who studied at K3, Malmö University. This section is based on the first part of the report.

The first part is the literature summary, where various examples of visual information are presented. Advantages, disadvantages and possible development paths for each graph are presented.

The report thus consists of the following three sections:

- Summary of the literature survey
- For further inspiration
- An appendix containing a summary of the articles and reports.

2 To be born in mind...

There are many reasons for why energy customers do not understand their invoices. To start off, electricity is not visible to the naked eye. The customer is generally unaware of environmental problems, and of the relevance of their own behaviour and their opportunities for changing behaviour. Briefly, it can be said that the customer does not experience that he has any control over his consumption (Fischer 2007). Secondly, it is necessary for the customer to perceive that he has some control of his own consumption, to get him to change his behaviour. It has been found that various kinds of feedback about energy consumption can give the customer an insight into their own consumption that is difficult to achieve by traditional energy bills. Equipping the invoices with tables and/or graphs can motivate a customer to understand and, in many reports, to also reduce his energy consumption.

There are a number of things to be considered when you decide the type of feedback to distribute.

- *How often should feedback be sent?* A number of reports have found that this is an important component that has to be considered. Above all, you have to find out how often it is at all practical to distribute information. In general, the more frequently the customer can receive feedback, the better is the result. It can be summarised by saying that it helps if you get feedback about your electrical consumption *at least* once a month.
- *What is needed from the user* to produce the type of feedback you decide to use? Different types of feedback require different types of information. If you choose to present a graph, for example, that compares the customer's consumption with the average consumption in the neighbourhood, you have to have the practical equipment for generating this average, but above all, you have to have access to the necessary information about the customer. Does the customer live in an apartment block or a private house? The group that the customer is compared with must be well-grounded; It does not give me any advantage to be compared with a block of flats if I live in my own house.
- *What happens if the customer is new*, or wants to change suppliers? Is the necessary information available? If you choose a graph that presents information based on both present consumption and previously consumed energy, for example, it is necessary to have a certain type of historical information available.

3 Basic conditions for good feedback

It has been found that there are a number of important factors to consider when you choose the way feedback is provided. They are listed by a couple of the reports that this text considers. A summary of the most important components is given below:

- The information must be easy to understand. At the same time, it must not be too facile. Customers can easily distrust information if it is not adjusted to the right degree of difficulty.
- Many surveys have shown that a combination of different means of expression give a considerably better result than if you just present the information in one way. A combination of graphs, tables and texts is regarded as being more efficient.
- A brief, informative text, together with a graph, can explain how the graph should be understood and also it is a good way to relate the graph to things that the customer can relate to. Many surveys showed that energy saving tips and other knowledge dissemination activities related to the graph are considerably more successful.
- Feedback must be supplemented by clear designations and explanations of abbreviations and technical terms.
- The customer must feel that the information in the feedback is specific to him. In other words, that the information is personal and aimed directly at the customer in question.
- Surveys have shown that information about saving money connected to the alternative chosen for feedback has to be presented to make the feedback effective.
- It is important to make a clear difference between the costs related to the actual consumption and the costs that are related to other parts of the invoice.
- Information must not mean that the customer gets much more paper sent home to him. In this case the customer could well perceive the situation, i.e. the sender, as being wasteful.

4 Different types of communication

There are two types of feedback that can be used, which are directly based on the information that comes in from the electricity meters. These are *Historic feedback* and *Comparative feedback*. The third type of feedback, which can not be directly based on information from electricity meters, but can be decisive as the basis for discussion, is called *Breakdown feedback*. In addition to these three ways to provide feedback, there is a fourth way to communicate, which is not generally directly linked to information from the electricity meters, but can still be a help in gaining better understanding of the invoices and the customer's own consumption – mainly in combination with one of the other ways to provide feedback. The fourth alternative is called *Advice about energy and energy saving* in this report.

Historic feedback is intended to make it possible for the customer to compare their current consumption with their previous energy consumption. For example, you can compare the current month's consumption with the same month last year. There is a number of ways to present this comparison

Comparative feedback is basically a way to relate a specific household's consumption to other households' consumption. For example, this could mean that you compare a specific household's consumption with the average consumption in the neighbourhood. Various problems are met in this means of presentation, including the way the comparison groups are selected.

Breakdown feedback, briefly, is showing the customer clearly how electricity is consumed, subdivided by household appliance and other energy-demanding products. This can not be done at present, by just processing the information that comes in from the electricity meters.

Advice about energy and energy saving is a type of communication which is intended to inform the customer. This could mean that you put energy saving tips directly onto the invoice, but it can also be a separate folder containing various types of feedback information and text that is distributed more seldom than an ordinary invoice. Advice about energy and energy saving works best if it is used together with one of the three feedback modes.

A common feature of the graphs used as examples and alternatives in the text, and which are also presented in this text, is that they have not been justified in a satisfactory manner. This means that we do not know why they have chosen to construct the graph in the way they have chosen. This information would have been very useful, since we do not now know the theories that lay behind construction of the graphs. The following graphs must therefore be regarded as being experiments and ad-hoc solutions. More basic work will be needed in future, for choosing and creating means of providing feedback.

4.1 Historic feedback

This is the most common form of feedback on electricity bills. More or less all the projects that have considered the subject have thought about and tested various types of historic feedback modes. The advantages and disadvantages found in these types of feedback are given below:

- + Consumers appear to be able to interpret and understand historic feedback information on bills.
- + It is possible to create robust comparisons, based on the data that is available to the company.
- + Tests have shown that customers prefer simple comparisons based on historical data when the information has to be put on the invoice.
- + There are surveys that indicate that Swedish customers are more interested in this type of feedback than any other type of feedback (see Fischer 2007).
- A few reports describe how test groups admittedly understood the historic comparison information, but there were indications of behaviour change.
- Historic comparison information has an ability to only motivate customers if consumption increases. This is because customers whose consumption does not increase might not see any reason to take a closer look at their behaviour.
- Problems may occur in provision of feedback for customers who are new or want to change suppliers. Data is only available for households who have already been customers for an essential time.
- Price changes, weather and temperature differences can make the presented feedback unreliable, since energy consumption is not always correctly comparable, for example if last year's cold and rainy June is compared with this year's warm and sunny June.

Various ways can be chosen to allocate this feedback as regards time. The following means of presentation has been chosen in the reports which form the basis of this text:

- presentation of last year's consumption through subdivision, quarter by quarter, where consumption for the same quarter this year is presented.
- presentation of last year's and this year's consumption through subdivision month by month
- presentation of last year's and this year's consumption through subdivision two months at a time.

There is also a presentation mode that only shows this quarter's consumption in relation to last year's. All these examples of historic feedback mentioned in this text use bar graphs for presentation.

4.1.1 Example 1

The first presentation mode is taken from a British project which attempted to find how they should provide feedback information on energy bills. Presentation is set up so that the customer can see the previous year's consumption, subdivided quarter by quarter, and the present quarter's consumption

CONCEPT A4

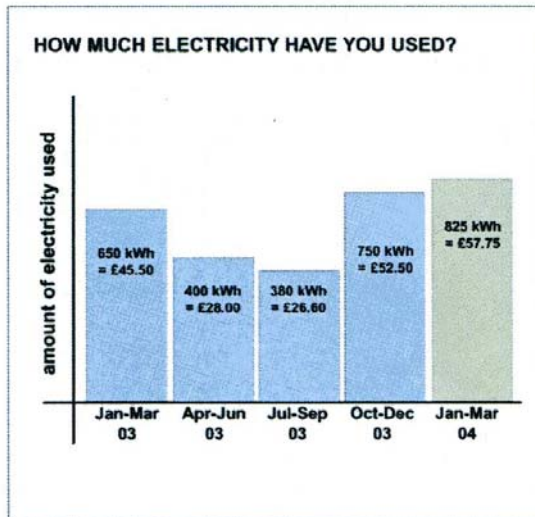


Figure 1: Example 1; Historic feedback. Source: Roberts, Simon. 2004. Consumer Preferences for Improving Energy Consumption Feedback. Report to Ofgem. Centre for Sustainable Energy.

In this example, the blue bars represent last year's consumption, the green bar represents this year's. In other words, the colours and the text under the bars distinguish the hypothetical bar from the other ones. At first sight, one might think that it would be easier to make a clearer distinction between the blue and green bars: a sharper colour contrast and to make the space between the blue bars clearer.

They have chosen to present both the amount used, and what it costs. In the hypothetical quarter, this meant "825 kWh = £57.75". Presenting the actual cost appears to be somewhat of an explanation for the customer: It becomes easier to understand what the consumption figures actually mean in money. For this reason, it is a good idea to put the figures inside the graph in this manner, to make it as clear as possible for the customer. At the same time, the model should be supplemented by a closer explanation of abbreviations and technical terms.

In the survey where this design was included, customers did not appear to be particularly enthusiastic about the model. It was found that there was an awareness that the data presented needed to be corrected, since both price changes and temperature differences would otherwise make it less accurate. The model did not appear to have enough visual impact to be noticed by customers.

Theoretically, the bill would have to be printed in colour if you choose a copy of the above model. It can work just as well, if not better, in black and white, however.

4.1.2 Example 2

The presentation mode below is taken from the same project as the above concept. The presentation is set up so that the customer can see this quarter's consumption related to the same quarter last year.

CONCEPT A

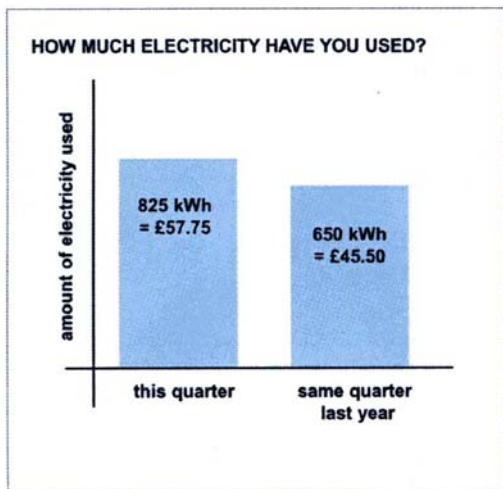


Figure 2: Example 2; Historic feedback. Source: Roberts, Simon. 2004. *Consumer Preferences for Improving Energy Consumption Feedback*. Report to Ofgem. Centre for Sustainable Energy.

The difference between the example above and the previous one is that there is only one colour, which is blue. This means that it is only the text that says which bar is which. In other respects, the graph is constructed in exactly the same way as above, apart from the fact that the information that is not linked to the quarter in question has been omitted. This results in a graph that gives the customer fewer figures to keep track of, at the same time as the total perspective becomes less detailed. It could be said that the information is also somewhat easier to keep track of, but the customer might lose perspective of the whole year.

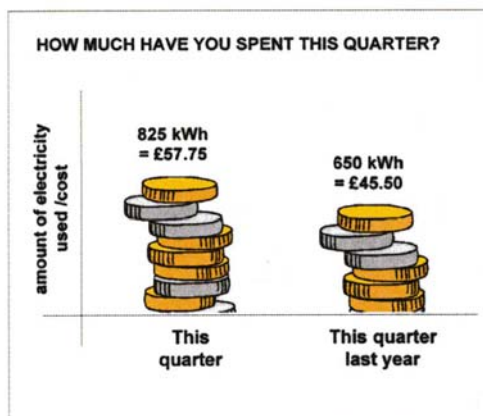
In the survey that this graph has been taken from, it gave the most positive result among all the graphs. Consumers thought that the graph was easy to understand, but that there were some questions about the designations (such as what a kWh really is) and which quarter should be put first. There was doubt about whether one really should react to what was printed in the personal graph. This shows that more than one way of providing feedback for the customers to consider is needed.

When this graph is used, the problems of temperature differences and any price changes still occur.

4.1.3 Example 3

The example is constructed in exactly the same way as in Example 2. They are taken from the same project and the differences are purely graphic.

CONCEPT A3



CONCEPT A2

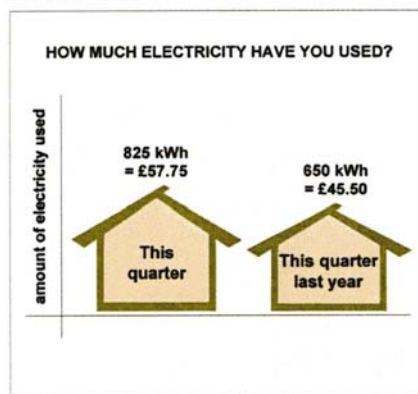


Figure 3: Example 3; Historic feedback. Source: Roberts, Simon. 2004. *Consumer Preferences for Improving Energy Consumption Feedback*. Report to Ofgem. Centre for Sustainable Energy.

The thing that was regarded as being interesting in these two graphs was whether a more playful graphic presentation would make the message easier for the customer to accept. One of the concepts symbolises consumption by heaps of money, whereas the other one symbolises consumption by using stylised models of houses. They have quite simply replaced the traditional bars with graphics which symbolise something more.

Both of these designs were rapidly rejected by the test personnel, as being superficial and distracting. The consequences of this type of more playful graphic presentation results in the consumer gaining an impression that the sender is less professional.

However, it is not inconceivable that a more carefully designed and imaginative presentation containing different graphic elements might give results.

4.1.4 Example 4

The following example has been taken from a Norwegian project which was intended to test and apply various forms of feedback information and that the customer, by reading the information, should be aware of his energy use and thus create a better platform for energy saving. It was also the intention to create better contact between the customer and the energy company. The graph is constructed so that the customer can see consumption subdivided two months at a time, where both this year and last year's consumption is presented.

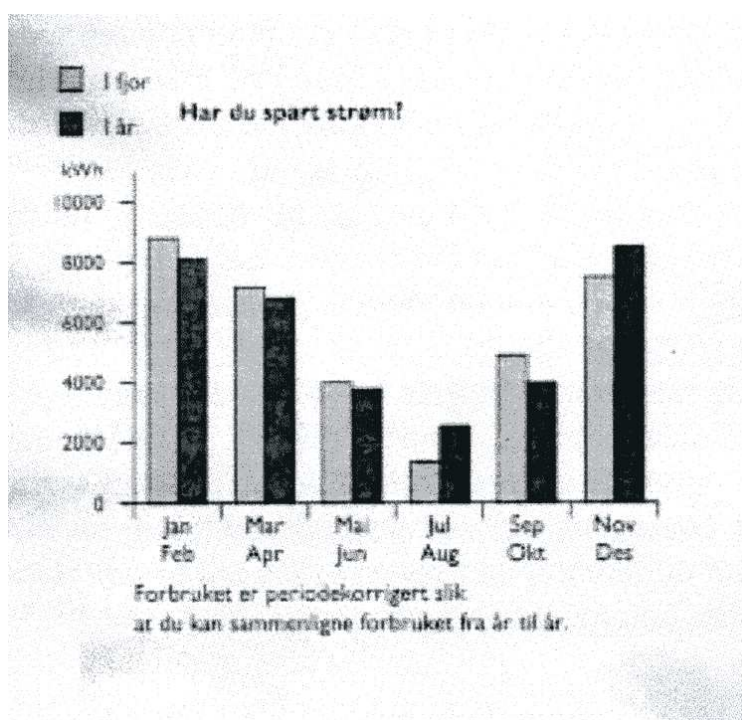


Figure 4: Example 4; Historic feedback. Source: Høivik, Asbjørn & Olsen, Johan-Gjemre. 1999. Advances in the use of consumption feedback information in energy billing: the experiences of a Norwegian energy utility. (Unfortunately, the quality of the illustration is not good. There was a sun in the background of the original illustration, which means that it looks "dirty" when reproduced.)

This example consists of a more strict graphic presentation. The colours used are black and grey. We can see that the grey bars represent last year's consumption and the black bars represent this year's consumption in the same period. The question asked in the graph, "Have you saved current" (*Har Du spart strøm?*), gives the graph a slightly different meaning than if the graph were presented without the text. Target-based feedback is based on the energy company setting goals for the consumer, which the consumer should aim to align his consumption with. Target-based feedback has been shown to give good results, and the question gets the consumer to look at the graph with a slightly different perspective – the goal is to save current. But if the answer to the question is "No, I haven't saved current since last year," the customer might put more effort into saving. On the other hand, if the answer is "Yes, I have saved current, the result could be that the customer justifies increased consumption next year. This, as has been mentioned previously, is a problem with feedback. It might be so that only the customers whose consumption increases would be motivated to get control over their consumption and gain better understanding of it.

They have chosen to leave out the actual cost, which was included in the three designs above. They have also chosen to leave out the actual consumption figures. You have to look at the scale on the left to see the height of the bar of interest. The customer is given fewer figures to keep track of, at the same time the result is that the graph becomes less accurate. It is possible to present more detailed information without making the graph difficult to understand.

The survey where this graph was included lead to customers reading their bills more often. They also found it easier to understand and many people gained a better appreciation of the development trend in their consumption. The graph also showed the potential for energy savings.

4.1.5 Example 5

This example is taken from a Swedish project which was intended to show what can be done to introduce simpler and more informative bills. The goal was also to make it easier for the customer to see how much energy had been consumed. The graph has been constructed so that you can see the consumption, divided up one month at a time, where both this year's and last year's consumption are presented. There is also a table on the right where consumption is shown in figures and is compared with a similar household

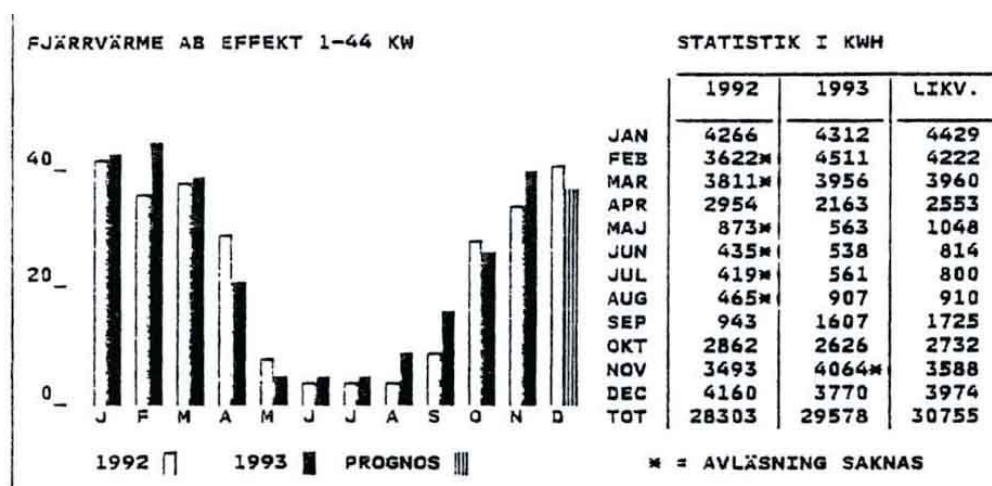


Figure 5: Example 5; Historic feedback. Source: Statistik på räkningen –bättre kontroll för kunden. Slutrapport från projektet för enklare, informativare energiräkningar i Helsingborg. NUTEK, Informationsenheten Gotab, Stockholm.1994.

The information is given with a somewhat less tidy mode of presentation. The white bars symbolise last year's consumption, and the black bars symbolise this year's. The broken bar represents this month. The same result can be seen on the right, but presented as figures. As mentioned previously, a combination of many different types of feedback is preferable. In this example, we can see that they also have included the comparative feedback mode. The third column entitled "Likv" (= similar) is given as a comparison between the customer's own consumption and the average consumption in a comparable household. The largest problem that occurred with this column was that test people had problems in understanding what "Likv" meant. Yet another example that you have to clearly explain what abbreviations and technical terms mean.

It is worth pointing out that this graph was prepared during the mainframe computer era, and at that time it was on the leading edge of what could be done graphically. Give the technology available today; the same content would doubtless have been designed differently.

Almost all the test people in the project found the bill easier to understand and check. Knowledge of energy use did not increase, however. Nor was it possible to verify whether electricity consumption fell.

4.2 Comparative feedback

Comparative feedback is the second most common form of feedback. Whereas historic feedback is regarded in most texts as being fairly self-evident as a feedback

mode on invoices, comparative feedback is at a somewhat more experimental stage. A number of advantages and disadvantages that have been found in using this type of feedback are given below:

- + This type of feedback can be inspiring for the consumer. If you see that somebody else's consumption is lower than your own, this can provide inspiration to change your own behaviour.
- + Surveys show that consumers might find themselves encouraged to review their behaviour if it turns out that they are above the average in a comparison group they regard as being valid.
- + Customers can access a type of goal-based feedback that has found to be fruitful in many cases.
- What should each household be compared with? It is not clear which type of comparison is best. There are a number of allocation methods, where some require more work than others.
- There may be difficulties in collecting the data needed to create correct and functional comparison groups.
- Comparative feedback modes were found in some surveys to have little or no effect on consumption. Whereas the procedure stimulates heavy consumers to introduce behaviour changes, it tells light consumers that they are really quite good and can actually afford to increase their consumption somewhat.

The main difference in different types of comparative feedback mentioned in the texts is the way that the allocation has been done. There are graphs that compare the consumer's own consumption with the average home (all counted), which compare the consumption with other homes in the customer's neighbourhood and which compare the consumer's own home with similar homes that are either well insulated or badly insulated.

4.2.1 Example 6

The two graphs considered below are taken from two different projects. The upper graph is taken from an American project which aimed at preparing the graph that was best suited to comparative feedback. The lower graph is taken from a Norwegian project that aimed to test and apply various forms of feedback and that the customer, by reading the information, should be made aware of his energy use and thus create a better platform for energy saving, and to create better contact between the customer and the energy company. Both graphs are constructed so that you, as the customer, should be able to see what your own consumption looks like, compared with other customers.

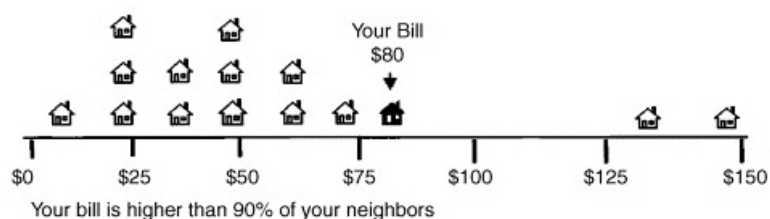


Figure 6 a: Example 6a; Comparative feedback. Source: Iyer, Maithili, Kempton, Willett & Payne, Christopher. 2006. *Comparison group on bills: Automated, personalized energy information*. Energy and Buildings, Vol. 38 s. 988-996.

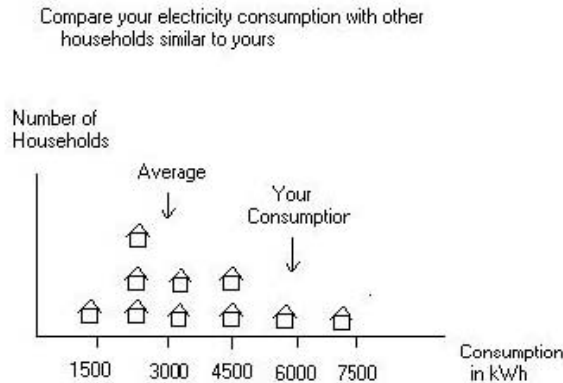


Figure 6 b: Example 6b; Comparative feedback. Source: Wilhite, Harold, Høivik, Asbjørn & Olsen, Johan-Gjemre. 1999. *Advances in the use of consumption feedback information in energy billing: the experiences of a Norwegian energy utility*.

These two graphs provide information in more or less the same way. The traditional curve has been replaced by small houses that are intended to symbolise your and other households. The upper example shows our house, which is coloured black. We also see an arrow which clarifies this, together with a small text that says that this is your bill on the scale. There is a line of text to read, below the graph. This says in plain language how our consumption relates to others'. In this example, you let the customer compare the actual cost of his consumption, as distinct from the lower example. Here, they let the customer compare his consumption in kWh. Even if this graph also says more or less the same thing, it has considerable differences. It looks much cleaner, graphically. The houses are shown in broken lines and do not contain so many details as the upper example. Your own consumption is only symbolised by an arrow, but they have also put in an arrow that describes where the average consumption ends up.

In the project from which the upper graph is taken, you can read that this model was preferred among all the others tested. This was the one that was interpreted correctly in most cases. One of the largest problems with graphs which are supposed to symbolise energy consumption in this or similar ways, that typical energy consumption has a very skewed distribution, where a few heavy consumers create a long tail on the right. This could lead the customer to gain an incorrect idea of what their consumption really is. In addition, the mean level is raised, although there are so few heavy consumers. This problem has been solved in the lower graph by cutting its tail off at a certain point. The latter graph did not succeed at all as well in the project it was taken from. It was regarded as being childish. In addition, it was found that the test persons did not understand whether one house symbolised one house or several households. For this reason, the survey chose to stop investigations into it.

The result is that we can now distinguish these two graphs, taken from two different projects, and which are based on more or less the same idea, but give two completely different results, where the upper one is regarded as giving the best result for comparative feedback and the lower one was rejected at an early stage. It is worth pointing out that the graph in Figure 6a comes from an American survey, whereas the

graph in Figure 6b comes from a Norwegian survey. The difference in perception can, of course, have been affected by cultural differences.

If you look at the graphic design, it is understandable that the graph in Figure 6b was regarded as being childish, oblique and angular lines that are supposed to symbolise houses and arrows. The small houses in the graph in Figure 6a are more detailed and you do not directly get the impression that it was just thrown together. At the same time, you can demand more from this graph. It could be made clearer. It might be a good idea to include a couple of the things found in Figure 6b – possibly measurement in kWh, but combined with the cost to give the customer a better impression. It is also possible to clarify how the figures and text are related to each other. One might also want to cut off the tail that is formed by heavy consumers and which cause the skewed distribution in the graph.

4.2.2 Example 7

This graph is taken from the same Norwegian project as above, and was intended to test and apply various types of feedback information. The intention was that the customer, having read the information, would become aware of their energy consumption and thus create a better platform for energy savings, and to create better contact between the energy company and the consumer. The graph is constructed so that the customer should be able to see what his household's consumption looks like, compared with other households and compared with the average.

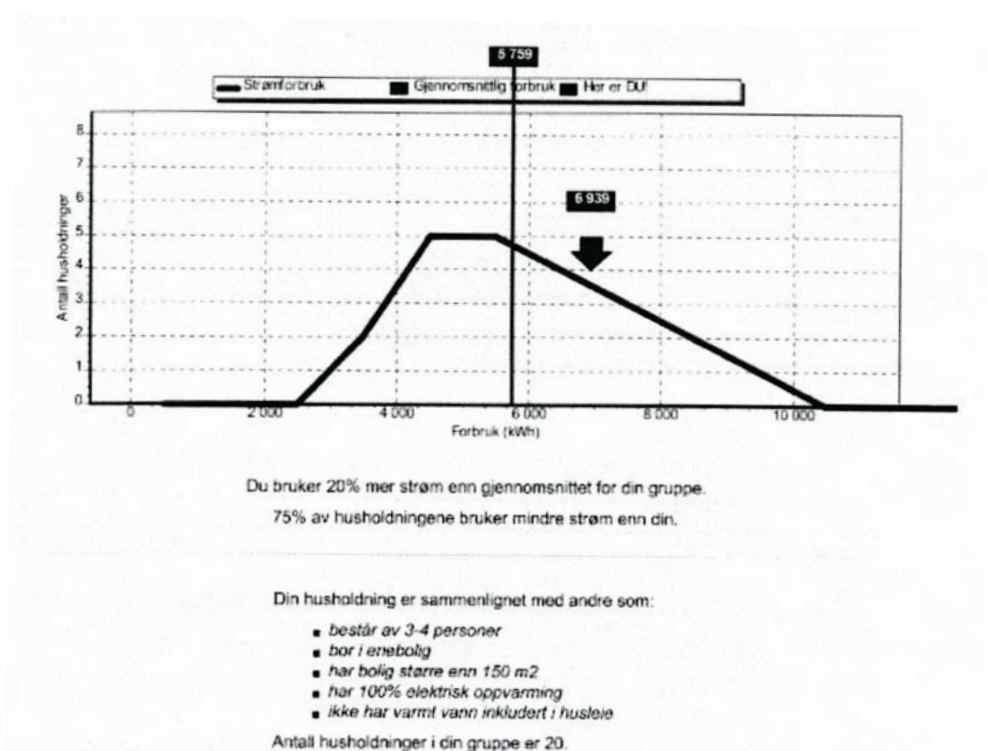


Figure 7: Example 7; Jämförande feedback. Source: Wilhite, Harold, Høivik, Asbjørn & Olsen, Johan-Gjemre. 1999. Advances in the use of consumption feedback information in energy billing: the experiences of a Norwegian energy utility.

This graph has really been constructed in the same way as in Example 6, but they have chosen to replace the houses with a simple curve. The curve shows what consumption looks like in the group that the household in question is compared with.

The arrow shows where you are on the curve, and the line that cuts through the curve symbolises where average consumption lies. They have chosen to only present consumption in kWh. Two lines of text under the actual graph contain a description of how they have subdivided the group that one is compared with. This is something that should be considered, since it gives the customer a deeper insight and at the same time, he can evaluate how well the group is positioned in relation to himself.

The curve can be difficult to understand, but a surprising number of the test persons who looked at the graph understood it well. Those who had difficulty in understanding its meaning were mostly people aged sixty and above. The customers who participated in the survey expressed that they would feel motivated to change their use of electricity if they found they were above the average.

4.2.3 Example 8

This presentation mode is taken from a British project which aimed at finding out how feedback information should be put on energy bills. The graph is constructed so that they could see how their own home's consumption compared with others in the neighbourhood.

CONCEPT C

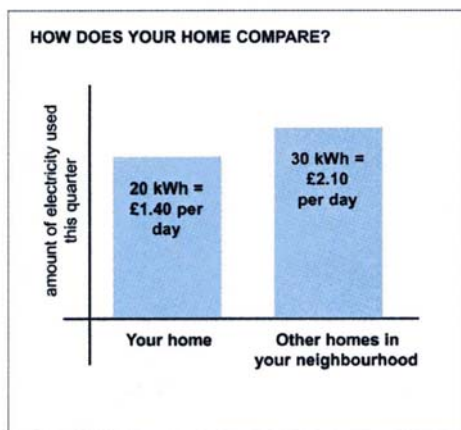


Figure 8: Example 8; Comparative feedback. Source: Roberts, Simon. 2004. *Consumer Preferences for Improving Energy Consumption Feedback*. Report to Ofgem. Centre for Sustainable Energy.

We recognise the graphic presentation from other examples in this text. The graph is very simple in design, containing two blue bars that symbolise the customer's own consumption and the average consumption in the area where he lives. We can read that the actual figures presented on the graph are based on the quarter's figures, but the same graph can be converted to any other time frame. The relatively wide bars make it possible to put in figures and text, to make it even clearer for the customer. More distinct delimitation between the bars, by using different colours would facilitate comprehension. As mentioned previously, it would be a good idea to present both the consumption and its cost on the graph, just as was done in the example above.

Surveys show that the neighbourhood might be the best comparison group for customers. It is possible to summarise data based on the actual neighbourhood. The data needed is already mostly available to the supplier, so you do not need to find out anything more about the households. Even if this subdivision method was shown by some surveys to not give the most precise comparison group, it could still be worth using the method since the information is already available to the supplier. The

biggest problem with this method of allocation is that the customer has every reason to distrust the figures – even if tests show that they coincide quite well with reality. The customer could dismiss the result by saying that all the houses are different and so they are not comparable to his own.

The test persons did not think that this example was very good, mainly since they thought that all the houses were different, and not comparable with their own. They also reacted positively to seeing that the bars showed that their consumption was lower than their neighbours'.

4.2.4 Example 9

This presentation mode has been taken from a British project which intended to find out how they should provide feedback information on energy bills. The graph is constructed so that the customer can see what electricity consumption looks like, compared with average consumption in general.

CONCEPT B

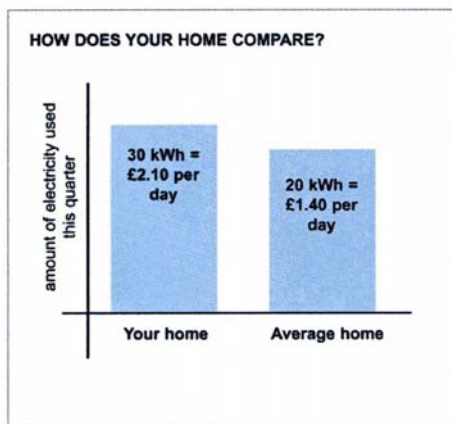


Figure 9: Example 9; Comparative feedback. Source: Roberts, Simon. 2004. *Consumer Preferences for Improving Energy Consumption Feedback*. Report to Ofgem. Centre for Sustainable Energy

The graph is constructed in exactly the same way as in Example 8. The graph has very a simple design, containing two blue bars which are supposed to symbolise the customer's own consumption and the average consumption of the neighbourhood where they live. We can read that the figures presented in the graph are based on the quarter's consumption, but the same graph can be re-used to show any other time aspect. The relatively wide bars make it possible to put in figures and text, to make it extra clear for the customer

The way that the material is subdivided in this graph differs from the one presented in Example 8. This one compares the customer's consumption with consumption in the average home. This could be a very uncertain way to divide things up. Test people rejected the above design, since they thought that it could not be taken seriously.

4.2.5 Example 10

This presentation mode has been taken from a British project which intended to find out how they should provide feedback information on energy bills. The graph is

constructed so that the customer can see the cost in relation to what the cost would have been if a similar home was badly insulated or well insulated.

CONCEPT K

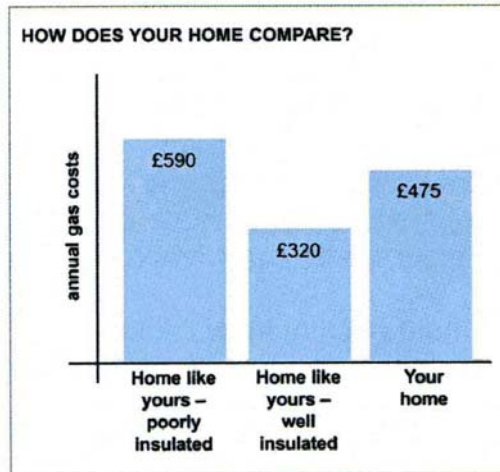


Figure 10: Example 10; Comparative feedback. Source: Roberts, Simon. 2004. *Consumer Preferences for Improving Energy Consumption Feedback*. Report to Ofgem. Centre for Sustainable Energy

This approach differs slightly from the other comparative feedback modes. We can see that the customer has his household's consumption compared with what it would have been if the home were well insulated or poorly insulated. Just as in the other examples from the same project, which have comparable graphic design using blue bars, there are number of questions related to whether they could have made the presentation clearer. Above all, it would have been a good idea if they had been able to make a clearer distinction between the bars, by using different colours on them.

The test persons who saw this design distrusted whether the suppliers really were able to provide this type of information. This shows that there is a high risk that this type of feedback could be rejected by consumers as being irrelevant, irrespective of how robust the information might be. But the actual idea of comparing customers with themselves in this way is good. It becomes a type of goal-based comparison, i.e. a comparison based on the customer himself, which has been found to give good results. The customer gets a feeling that he could have saved money if he had acted differently, and some results show that the idea that one could save money could be a carrot that attracts changes in behaviour.

It might have been possible to modify this presentation mode so that the customer could believe the information and, at the same time, gain a similar type of goal-based comparison.

4.3 Breakdown feedback

Breakdown feedback is the type of feedback that was discussed least frequently in the texts on which this survey is based. Since it has nevertheless been mentioned in some texts, and has demonstrated interesting results, the mode is of interest. Even if it can not be done at present, by just using meter readings, it is a feedback mode that could be useful to discuss in future projects. A number of advantages and disadvantages found in using this type of feedback are listed below:

- + Since there is a general lack of knowledge among consumers, about what actually consumes energy in their homes, this type of feedback could be a good indicator and by extension, possibly the best way to give the customer the impression that they could be in control of their consumption.
- + Allows clear, simple diagrams to be used, which surveys have found to be understood and liked by consumers.
- + There are functional solutions whereby the customer provides the information that makes it possible to create the break-down feedback. There are Swedish energy suppliers and energy advisers who currently provide something similar.
- It is based on information which can not be obtained at present from meter readings.
- Really reliable data about the efficiency of this type of feedback is difficult to find.

There is really only one type of diagram for this feedback mode, the pie diagram, where the slices represent energy consuming products. The other method is based on an interactive Internet based method.

4.3.1 Example 11

The following example is taken from a Danish project, which aimed at reducing electricity consumption in homes. The diagram has been designed so that the customer can see his consumption broken down by various energy consuming components in the home.

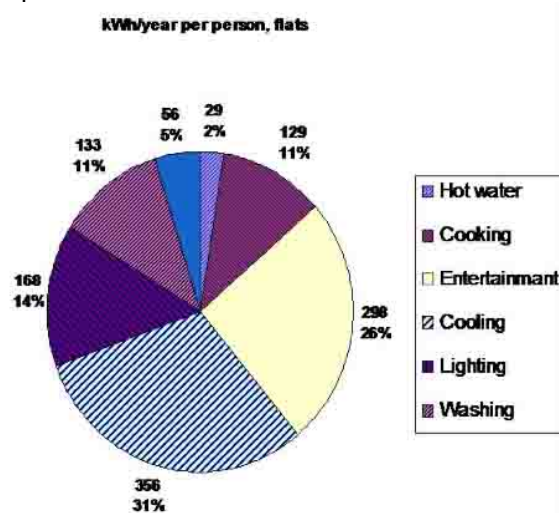


Figure 11: Example 11; Breakdown feedback. Source: Brange, Birgitte, Fjordbak Larsen, Troels, Wilke, Göran. 2007. *Campaign effects and self-analysis Internet tool*. ECEEE 2007 Summer Study. Saving Energy – Just Do It!

Many projects have taken up this type of graph as an excellent choice for presenting breakdown feedback. Only this example is presented in this text, mostly because all the others are designed in more or less the same way. The difference between one model and another to some extent is what the various slices contain – i.e. how one subdivides the energy consuming components in a home. The above design is a typical pie diagram, where each slice of pie has been clearly, but not very beautifully coloured. The idea behind giving each part of the diagram a different colour or its own

pattern is excellent, but a consistent choice of colours or patterns is important for clarity.

Many tests have shown that this type of diagram is received in a very positive manner by consumers. It has proven to be unbeatable in being easy to understand and at the same time, gives a very clear picture of what consumption looks like in the home. It is easy for the customer to see what it is that uses energy in the home, making it relatively easy to use in making changes in behaviour.

The obvious problem with this type of diagram is that the results are based on information that was not directly available to the supplier. For this reason, it needs more than just the information from the electricity meters to make it possible for consumers to receive this type of information.

4.3.2 Example 12

This design has been taken from the same Danish project as Example 11, above, has been taken from. The design is based on the customer providing information themselves, which is needed to allow the breakdown feedback to be prepared.



Figure 12a: Example 12a; Breakdown feedback. Source: Brange, Birgitte, Fjordbak Larsen, Troels, Wilke, Göran. 2007. *Campaign effects and self-analysis Internet tool*. ECEEE 2007 Summer Study. Saving Energy – Just Do It!

The idea is that customers should use an Internet based portal to get a personal analysis of their own electricity consumption. The Internet site functions as a type of form-based calculator, which estimates the consumption of household machinery. In this type of system, provision of the necessary information is in the customer's hands. In exchange, they receive customised saving ideas and saving advice. The questionnaire also allows the user to compare their results with similar households.

If you want to obtain a full analysis of the household, or are interested in obtaining a more detailed or specific analysis, this should be possible according to the survey, depending on the information that is supplied.

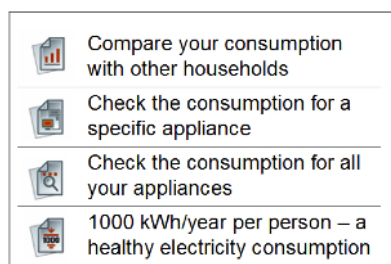


Figure 12b: Source: see Figure 12a.

The question is if customers are prepared to do the extra work needed to access the information offered. The result of the project that this model was included in was not particularly impressive, with relatively few users. However, the information that appeared to be possible to obtain via the model appeared to be interesting to the households who felt called upon to understand their electricity consumption better.

4.4 Advice on energy and energy saving

This type of information is mentioned in a number of reports as being a very important component in communication. The advantages and disadvantages of using this type of information are listed below:

- + Surveys have shown that feedback must be combined with advice about energy and energy saving to have any effect.
- + Could well be combined with all of the above-mentioned types of feedback.
- The customer only finds the information useful if it is presented the right way, i.e. it must be aligned with his specific needs.

Not many examples and alternatives are presented in the texts; only one project has done tests on real material. This is presented below. Many texts mention information feedback as being indispensable, but the reason why they have not included any concrete examples has not been included in the reports.

4.4.1 Example 13

The following example is set up as an extra information folder which is mailed together with the invoice. The intention was not that it should be included in all invoice mailings, it was mainly intended for quarterly dispatch.



Figure 13: Example 13; Advice about energy and energy saving. Source: Roberts, Simon. 2004. *Consumer Preferences for Improving Energy Consumption Feedback*. Report to Ofgem. Centre for Sustainable Energy.

The illustration above shows the prototype that was prepared and tested on the test persons included in the project. This example was rejected, however. The participants said that this type of information was the sort of thing that they threw away without thinking. The actual idea was not rejected however, they felt that it was merely this particular procedure that was disliked.

If you are going to distribute this type of supplementary information, it must be carefully prepared and designed in such a way that customers do not perceive it as being disturbing and unnecessary. The personal element must be included here as well, so that the information folder does not feel too general, and thus not necessarily relevant to the customer in question.

4.4.2 Example 14

The following example is intended to serve as an annually recurring report, where the household's total consumption is reviewed, presented and commented.

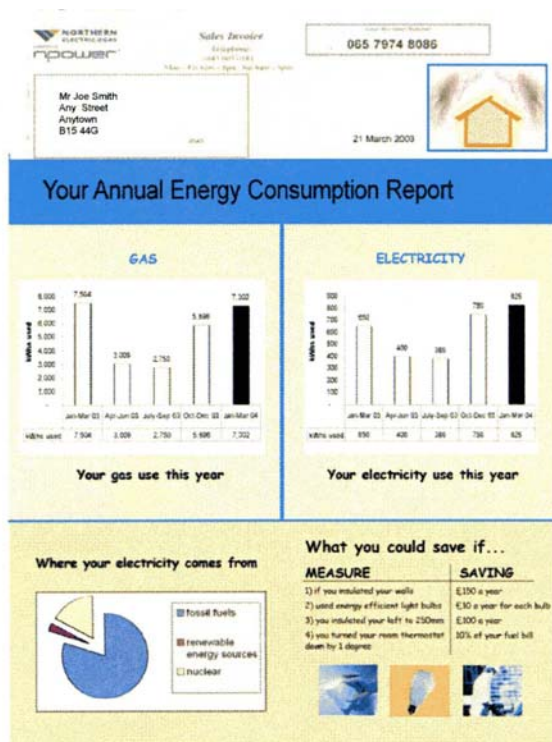


Figure 14: Example 14; Advice about energy and energy saving. Source: Roberts, Simon. 2004. *Consumer Preferences for Improving Energy Consumption Feedback*. Report to Ofgem. Centre for Sustainable Energy.

The idea is that the customer should have their energy use behaviour commented by this annual mailing. The personal factor can be made high by giving tips and advice about energy use, based on what it actually looks like. The survey results showed that this idea generated a lot of interest. It is possibly unavoidable that some customers will regard this type of information as junk mail, but this deeper annual analysis generated interest.

4.4.3 Examples 15 & 16

This design is based on putting a box on the invoice, in which they present a freefone number that customers can call if they want help or have questions about energy use.

NORTHERN ELECTRIC & GAS
npower

Sales Invoice
Telephone: 0845 601 0181
Main • Ftg Rate • Appl. • Nat Rate • Spn

Year Account Number
065 7974 8086

Mr Joe Smith
Any Street
Anytown
BT5 4AG

3645

Date of Account: 17 December 2002

THIS IS NOT A TAX INVOICE

Description	GAS	£	p	Amount
				£
Amount Due On The Last Account		55	75	
Payment 23 September 2002		27	000R	
Payment 24 October 2002		28	000R	
Payment 21 November 2002		25	000R	
Balance Brought Forward				21.27GR
Tight GASSTOP MCO				
Standing Charge 21 August 2002 to 03 December 2002				
134 days at 0.000 pence per day		0	00	
Unit Charges	1927 @ 2.05000p	39	50	
Gas Charges This Period				39.50
VAT: 100% Of Gas Charges	39.50 @ 5.0%			1.97
				20.20

FOR INFORMATION ONLY

 You could be saving £200 a year off your fuel bills by making energy efficiency improvements to your home.
Telephone our freephone energy efficiency helpline on 0800 000 000

Figure 15: Example 15; Advice about energy and energy saving. Source: Roberts, Simon. 2004. *Consumer Preferences for Improving Energy Consumption Feedback*. Report to Ofgem. Centre for Sustainable Energy.

Some interest was shown in this type of information, but many customers felt that they wondered if it could really be so that the energy companies were truly interested in having their customers review their energy consumption. However, a freefone number offering advice on energy matters has been mentioned in a number of reports as being a good complement to feedback.

We have targets to save you energy.

We've a wide range of offers to help you – are you getting your share?

 **Call us FREE on 0800 111 111**

Figure 16: Example 16; Advice about energy and energy saving. Source: Roberts, Simon. 2004. *Consumer Preferences for Improving Energy Consumption Feedback*. Report to Ofgem. Centre for Sustainable Energy

5 Concluding reflections

The new Energy Services Directive introduces a requirement for information to customers about how they can reduce their energy consumption, as was mentioned above. Invoices are of interest, since most of them provide a unique opportunity for energy companies to communicate individually with their customers. Every invoice offers a unique opportunity of communicating with customers. The question that then becomes central, of course, is how the information should be provided visually so that customers understand it, perceive it positively and in extension, also change their behaviour and habits on the basis of this knowledge?

As for the design of the graphs in the articles and reports included in this literature survey, we can only state that no motivation for the choice of graphs could be found, which is unfortunate. It would have been instructive to learn about the considerations made when choosing a graph. For this reason, the graphs must be regarded as being an experiment and something of ad-hoc solutions. More basic work will be needed in future, in the selection and creation of feedback modes.

There does not appear to have been any example among those that have been mentioned in the literature survey, which fully meets the requirements for full feedback. This means that there is no obvious solution at present to the question of the way in which consumption should be presented graphically. A number of thoughts are given below, which might be of some assistance. They are based on the literature survey and can be seen as an indication for the direction in which continued work should go.

- A combination of different feedback modes would be preferable. Historic feedback combined with one or two of the other feedback modes, and combined with some kind of advice about energy and energy saving should combine to give quite good results..
- When historic feedback is created, the time aspect is an important matter. You have to decide how far back in time to present the comparison and the way in which the information should be divided up. Monthly allocation admittedly gives a lot of figures and bars for the customer to keep track of, but this should not be a problem if the graph has been carefully designed. You have to remember that the customer could disbelieve or misunderstand information since weather conditions differ from year to year, and there does not appear to be any good way to counter this.
- Target-based feedback might be preferable when comparative feedback is used, since this allows the customer to compare their consumption in relation to their own household (the household that the customer might find easier to accept obtaining correct and acceptable comparisons). You also avoid problems related to creation of acceptable comparison groups. Feedback becomes highly personal and the risk that feedback only encourages heavy consumers to change their behaviour is reduced.
- Since breakdown feedback can not be done at present, by just reading the meters, this feedback mode easily ends up in the background. At the same time, you have to think that this feedback mode might be the one that gives the best result. Bearing this in mind and aiming at allowing customers to receive breakdown feedback at some future date is not a bad idea.

- Advice about energy and energy saving should be included and should be related to the other feedback modes. There are no complete solutions or actual examples included in the reports that this text covers, so this section will require more work. Advice about energy and energy saving must feel personal and be related in some way or other to the invoices or other material that the customer receives.

6 For further inspiration

Visual communication is a very central part of our culture. Facilitating understanding of sequences, events, flows etc. by using various types of graphic presentations has become increasingly more common. The use of both text and images, and the way that they collaborate and cooperate with each other opens up the probability of good communication. The goal is, of course, communication where both parties feel satisfied and are given the opportunity of acting.

The new Energy Services Directive demands that information about their energy consumption should be given to customers, on media including their invoices. How should this information be designed so that customers understand it, perceive it in a positive manner and, in extension, also possibly change their behaviour and their habits on the basis of this knowledge? This literature survey has covered various ways of presenting energy consumption graphically and how customers have perceived the presentations. In this section, we look ahead. The goal of this section is to demonstrate solutions and to provide some inspiration for the coming work of making presentations of their consumption to the customers.

The principles for graphic excellence, as propounded by Edward Tufte (1983) are:

- Graphic excellence is the well-designed presentation of interesting data – a matter of *substance, statistics* and *design*.
- Graphic excellence consists of complex ideas which are communicated with *clarity, precision* and *efficiency*.
- Graphic excellence is what gives the viewer the maximum number of ideas in the shortest time, by using the smallest possible amount of ink on the smallest possible area.
- Graphic excellence is almost always multi-variable, i.e. it refers to more than one variable
- And graphic excellence demands that you tell the truth about the data.

Saul Wurman (1989) says that you can only understand facts and figures if they can be related to concrete, comprehensible factors. If you make comparisons, the comparison object must be something you understand.

This means that new knowledge is based on already known knowledge. In order to understand something new, we have to base it on something we already know. Knowledge can never be created in a vacuum. It is always related to something else and is created in collaboration with other people.

This section consists of two components. Some slightly older examples are given first, in which the creators have attempted to visually communicate complicated and complex things in an ingenious and subtle manner. None of them have anything to do with energy or electricity, but they are all related to human activities. Then follow some ideas, sketches and suggestions that have been created using this literature survey as a background. It is intended to serve as a source of inspiration for further work, by

adding graphic communication about energy consumption to the invoices sent to households.

6.1 Some older examples

All of us have struggled with various mathematical and geometric problems at school. A book was published in England in 1847, written by Oliver Byrne, *The First Six Books of the Elements of Euclid in which coloured diagrams and symbols are used instead of letters for the greater ease of learners*, where he attempted in a highly unconventional way to depart from the traditional way to describe and set up geometric problems. He used four basic colours and simple graphics.

Byrne's explanation of Pythagoras' theorem is shown below, a theorem in Euclidian geometry. Byrne's method of using colour focuses on the knowledge to be communicated, *colour as information*.

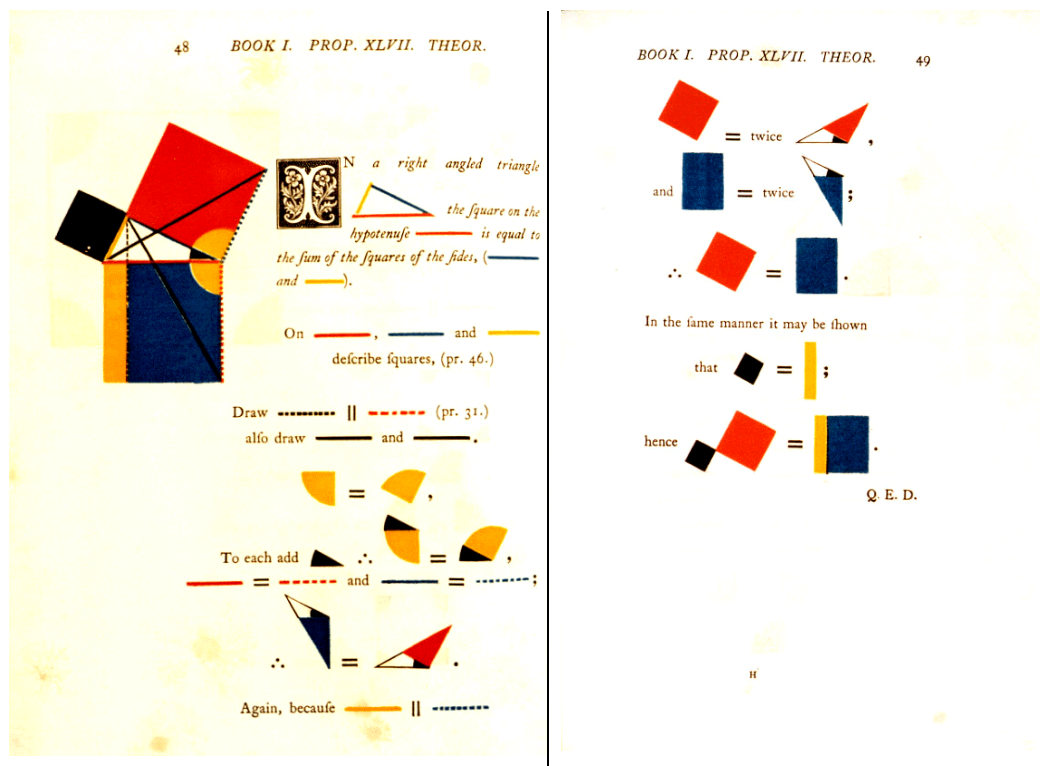


Figure 17: Byrne, Oliver: 1847. *The First Six Books of the Elements of Euclid in which coloured diagrams and symbols are used instead of letters for the greater ease of learners*.

A graphic presentation can also be used to communicate shaking, dramatic events in history. One classic presentation was made by Charles Joseph Minard (1781-1870) about Napoleon's invasion of Russia in 1812. The first version of the map was made in 1861 and a coloured version was made in 1869.

It starts on the left, by the Polish-Russian border, close to the river Niemen. The thick line indicates the size of Napoleon's army, 422,000 men, when they invaded Russia in 1812. The width of the line indicates the size of the army at each point on the map. In September, when the army reached Moscow, there were only 100,000 men left. The retreat from Moscow is the lower, black line, which is linked to the temperature and

[illegible]

In 1933, Harry C. Beck (1903-1974) drew what is probably the world's best-known map, the map of the London Underground. In the early days, they drew the lines and stations on ordinary street maps, but they were difficult to read and as the Underground lines grew and were extended, the map became more chaotic and difficult to read.

The map has formed a school, and is used all over the world by different transport companies. When you see a map like this, you know at once that it relates to transport, and how you can get from point A to point B.



Figure 19: Source: Transport for London

If one had followed the geographic principle and used Beck's graphic design, the map of the London Underground would have looked like the next illustration. The map only covers Zone 1, Central London. The geographic design gives a completely different impression when the focus is on the geographic relationship, compared with how you can travel from point A to point B.

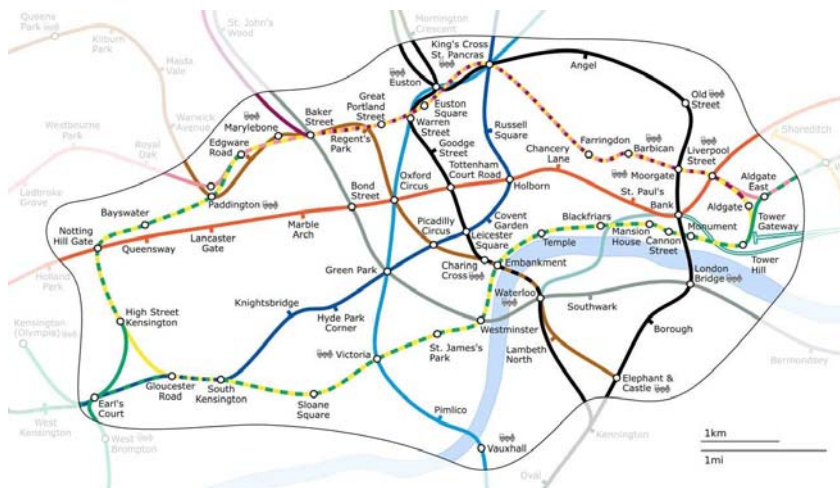


Figure 20: Source: <http://en.wikipedia.org/wiki/2007-07-30>

6.2 Inspiration for presentation of consumption on invoices

In this literature survey, we have asked the question of how information about consumption should be designed visually, so that customers would understand it, perceive it in a positive manner and in extension, also change their behaviour and their habits on the basis of this knowledge. Invoices are useful for communication,

since they are individual and give the energy companies a unique opportunity to communicate with customers.

Communication is also a process. This means that the energy companies can continually provide their customers with feedback, tailor information and thus create good communication between customer and company. Individualisation also means that there is a unique opportunity to provide feedback in several stages. This also means that information can come in "reasonably-sized" portions, suited to the customer and the customer's consumption.

The suggestions below are based on this facility for individual communication and are based on the results of the literature survey.

Scenario

The customer, Tove, a young working woman in mid-career, receives an information folder together with her invoice, which is individualised and has her consumption in the centre. Tove lives in an electrically heated terrace house of 120 m² (1,300 sq. ft.) together with her partner. In addition to the usual household appliances, she uses a stereo, washing machine and a tumble-drier. She also uses her computer quite a lot, since she often works at home, and it is connected to the Internet.

The energy company feedback provides feedback in different ways during a period of time.

The first example is the information brochure, where the customer is introduced to consumption reports. Tove's consumption is briefly presented, explanation to various concepts are provided, plus a few energy-saving tips

Energy-saving tips will be included every time, preferably individually designed.

In the second example, some time has passed and feedback accordingly looks different. It is now possible to read consumption in a longer time series. The energy company introduces goals here, and also a goal for Tove's consumption. The goals are linked to the general environmental goals in the Kyoto protocol.

In the third example, more time has passed. It is now time to reconcile Tove's consumption with the goals that the energy company has set for her consumption. The energy company initiates a "dialogue" with the customer about her electricity consumption. It can be time for roses or brickbats.

These are suggestions, sketches and ideas for what graphic communication could look like. The idea is that there could be inspiration for communication between energy companies and the customer.



Hej Tove!

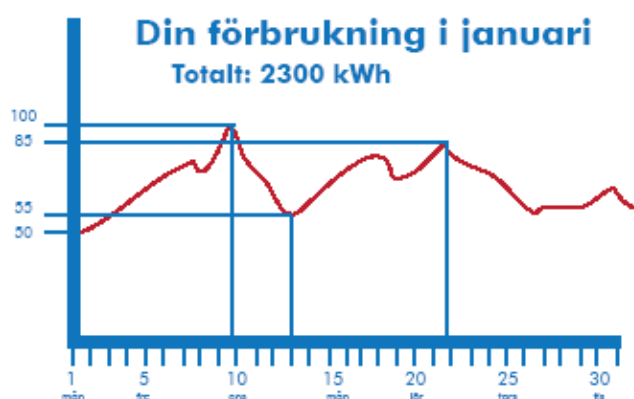
4 februari 2007

Varje månad tillsammans med din faktura kommer du från och med nu att få uppgifter om hur din elförbrukning ser ut. Du kommer att kunna se hur stor din förbrukning av el har varit den senaste månaden, och så småningom kommer du också att kunna se hur den ser ut över hela året.

Du kommer också att få tips på hur du kan bli en smart energikund. Många elektriska apparater drar ström även om det inte märks. Har du din TV på stand-by så förbrukar den ström hela tiden, inte mycket varje dag, men under ett år blir det en del. Varför betala för el som du inte har glädje av utan som bara försvinner ut?

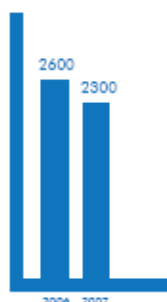
Din förbrukning i januari

Totalt: 2300 kWh



Är det stor skillnad mellan de olika dagarna? Försök fundera ut vad du gjorde de dagarna du har högst förbrukning.

Din månadsförbrukning jämfört med förra året



Vad är 1 kWh?

1 kWh = Ett el-element på i 1 timma

Alla apparater som drivs med el är märkta med ett Wattal som anger effekten. Den energi som går åt när du använder apparaten mäts i Wattimmar. En apparat med effekten 1 000 W som används i en timme, förbrukar då 1 000 Wattimmar, vilket är samma sak som 1 kWh.

Om du till exempel har ett elektriskt värme-element med effekten 1.000 W på i 1 timma, så förbrukar du 1 kWh

Tips

- Har du för hög innetemperatur? En grads sänkning sparar 5%
- Vädra snabbt och effektivt
- Duscha inte onödigt länge
- Minska varmvattenförbrukningen med snålspolande munstycken



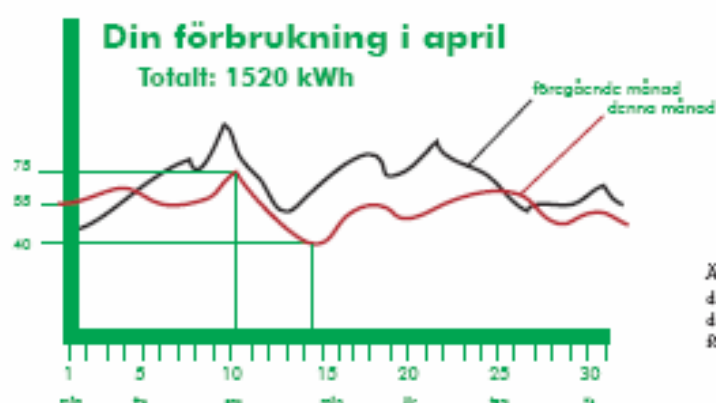
Hej Tove!

4 maj 2007

Under det senaste året har miljöfrågor och den globala uppvärmingen diskuterats mycket. Filmen En obekväm sanning med den amerikanska presidentkandidaten Al Gore i huvudrollen har fått många fungera som en vickarklocka.

Det är viktigt att minska utsläppet av växthusgaser. Enligt Kyoto-avtalet skall Sverige minska utsläppen av koldioxid med 4% till 2012, och nyligen har Europeiska Rådet utlett sig att medlemsländerna behöver minska utsläppen med minst 20% till år 2020. För att kunna uppnå målen måste vi hjälpa ihjäl genom att försöka minska vår förbrukning av el och energi. Vi kan alla bidra, och varje bidrag är viktigt!

Vi har gjort en kalkyl och satt upp ett mål för alla våra kunder, som du ser längre ned på sidan.



Din månadsförbrukning jämfört med förra året



Ditt miljömål

Till vänster ser du "ditt miljömål", en månadsförbrukning för april som vi räknat fram för ditt hus. Det ska ses som ett gemensamt sparmål för hushåll av ditt slag, alltså milhus med elvärme. Enligt genomförda beräkningar kan man på ett litet hus spara och på ganska kort tid spara över 15%. Du kanske kan göra ännu mer? Ta reda på mer om vad just du kan göra för ledtrådar – inom kampanjen "Bli energisnål" finns informationsmaterial, vinningskus och information på www.energimyndigheten.se

Tips

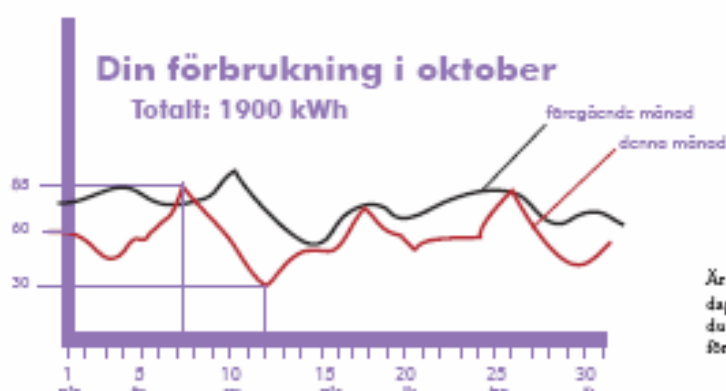
- Testa med full maskin. Tvättmaskinen förbrukar nästan lika mycket energi halvfull som full!
- Slapa ströveten om det går
- Välj om möjligt lägre cykeltemperatur
- Utnyttja maskinens eventuella sparprogram



4 november 2007

Grattis! Du har sänkt din förbrukning de senaste räknedena, och du börjar näma dig målet för din förbrukning. Samtidigt som du hjälper till att uppnå miljömålen, så har du också haft mindre avgifter för din el.

Den senaste räkningen har varit en ganska kall månad, och det innebär att energiförbrukningen i hela landet varit högre. Trots det så har din elförbrukning inte varit lika hög som tidigare för noll temperaturen krapit ner. Det är bra!



Din månadsförbrukning jämfört med förra året



Vad är 1 kWh?

1 kWh = Husets rumsbelysning tänd i 1 timma

Alla apparater som drivs med el är märkta med ett Wattal som anger effekten. Den energi som går åt när du använder apparaten mäts i Wattimmar. En apparat med effekten 1 000 W som används i en timme, förbrukar då 1 000 Wattimmar, vilket är samma sak som 1 kWh.

Alla lampor i ett genomsnittligt svenskt småhus har ca 1.500 W effekt. Om man låter 1.000 W av detta lysa under 1 timme så förbrukar 1 kWh.

Tips

- Släck ljuset i rum där ingen vistas, att tända och släcka drar inte mer!
- Byt ut glödlampor mot lyfte och lågenergilampor
- Spara miljön genom att köpa lyfte med låga kvackthvertneshall
- Rum med ljusa väggar och golv behövs inte lika mycket belysning.

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APPENDIX: SUMMARIES OF REPORTS AND ARTICLES INCLUDED IN THE LITERATURE SURVEY.

Note! All the references in the following texts are to the appropriate article or report!

Bengtson, Kevin. 1997. *Can Better Utility Bills Save Energy?* Home Energy Magazine Online May/June 1997.

Added nothing new, or was regarded as being not very relevant for the purpose.

Bottrill, Catherine. 2007. *Internet-based tools for behaviour change*. ECEEE 2007 Summer Study • Saving Energy – Just Do It!

Added nothing new, or was regarded as being not very relevant for the purpose.

Brange, Birgitte, Fjordbak Larsen, Troels, Wilke, Göran. 2007. *Campaign effects and self-analysis Internet tool*. ECEEE 2007 Summer Study • Saving Energy – Just Do It!

A TV campaign was launched in October 2006, with an Internet-based portal intended to get electricity consumption down to 1000 kWh/year.

Material

The Danish Energy Board launched the programme which was aimed at the people of Denmark. They estimated that savings could amount to 170 kWh per year and per person for apartments and 535 kWh per year and person for private houses. (This, in

its turn, means savings of 2 TWh per year, 500 million Euro or about a million tonne CO₂).

Method

The text says that they did a survey which showed that only 30% of the respondents knew their exact energy consumption, and only 3% know what level it should be in relation to the size of the household. A web site was launched at the same time as the TV campaign, allowing households to analyse and understand their electricity use better. The web site has four central components:

- Comparison information
- Default profiles
- Statistics for household appliances
- Personal energy saving advice

One of the most important tools is a questionnaire-based calculator which estimates the consumption of household appliances. Either for all appliances together, or for one machine at a time. Background information and saving ideas are presented together with the questions. Specific saving advice is generated, automatically, based on the questionnaire. As the user, you can also compare yourself with similar households (based on type and size of building, family etc.).

Figure 1 shows the four simple choices you have in the finished site. *Figure 2* shows what the questionnaire looks like. If you want a full analysis of the household, this can be done, and you can also go in to more detailed or specific analyses.

Result

The text says that the web site was only posted for a couple of months, but that 4,000 unique users have visited it. And 350 of these people have saved a profile.

Bruel, René. 2007. *BEHAVE. Meta-evaluation of communicative programmes aimed at consumers*. ECEEE 2007 Summer Study • Saving Energy – Just Do It!

Added nothing new, or was regarded as being not very relevant for the purpose.

Darby, Sarah. 2000. *Making it obvious: designing feedback into energy consumption*. University of Oxford.

Purpose

The text started a survey which covered the extent to which households can teach themselves about energy use in a way that teaches them many things: by using feedback signals from their own actions and their own consumption.

Method

The author writes that we think about energy in three ways:

- As a good: many principles of action are based on the assumption. After deregulation of the suppliers, customers have become more aware of energy prices, but only have glancing contact with the financial cost of their energy services when they receive an invoice, a bank statement or when they change supplier..
- As a social necessity (or as a basic human need). Users of modern energy systems, and especially those who live in poverty must understand how they can control their energy use to best advantage, and need access to help when necessary. Feedback and information must be available, clear and easy to understand, for this to work.
- As an ecological resource: This means that energy use never occurs without side effects. Production of energy requires mining, tree felling, farming of fuel crops, gas and oil extraction, construction of dams, pipelines, power lines and power

stations. However, the side effects of using electricity and gas - carbon dioxide and other waste gases - are not visible. This invisibility becomes real through various events; by connections with major, hidden distribution networks; through lack of thought about energy unless it becomes expensive or there is suddenly not enough; through design for comfort or the suppliers rather than for visibility and awareness; and through obscure measurement and counting systems.

These energy concepts show that consumption has extensive financial, social, ecological and cultural aspects which have not been sufficiently well identified.

The text describes that environmental policies aimed at reducing energy consumption have failed to correctly understand the critical link between our feeling for the environment and our daily needs and actions: there is a need to acquire knowledge and this is done by focusing how people connect their lives with the environment.

The text covers a procedure that is intended to reduce discharge. It starts from existing pathways in energy use, in the customer's cultural context and their perception of needs and ambitions, which aims at identifying the process by which people can come to use energy in a more environmentally-friendly manner. The text focuses on the process which gets people to learn by "trial and error", to use energy in an ecological manner.

According to the text, there are different types of feedback. Two which are covered are direct and indirect feedback.

Direct feedback: is available on demand. Learning by looking and paying. This includes:

- direct displays. Customers who have their delivery measured in a traditional manner seldom consult their meters: It is either hidden or difficult to understand. More attractive and user-friendly displays which are now available are shown to lead to energy savings and better awareness..
- interactive feedback. This is done via a computer and has been found to be an obvious candidate for future development.

Indirect feedback: raw data is processed by the supplier and is sent to customers. Learning through reading and reflecting.

- more frequent billing, based on meter readings, not estimations.
- more frequent billing based on meter readings plus historic feedback – comparison between same period last year, with weather compensation.
- more frequent billing based on meter readings plus normative feedback – comparison with similar households.
- more frequent billing plus "disaggregated" feedback. A quite expensive but popular feedback when tested.
- more frequent billing plus offers for auditing or discount for efficiency measures.
- more frequent billing plus detailed annual or quarterly energy reports.

Material

38 research projects aimed at feedback which have been carried out during a 25 year period.

Result

Research projects showed the possibilities of some types of feedback and also some of the things which affect interpretation of the results.

The text describes that feedback is a considerable component of the work in creating awareness and frugal use. Savings that were obtained from the 38 projects are reported in *Table 1*.

Awareness is difficult to measure, but an increase in awareness was discovered in half the projects. The text regards it as being impossible to study each survey in detail. But it seems that direct feedback, alone or in combination with other factors, is the most promising type. Almost all the studies involved in direct feedback showed savings of 5% or more. Direct feedback combined with some type of information or

advice gave savings of about 10% in four programmes that were aimed at low income households.

As for indirect feedback, the extent of savings is not as high, but considerable levels could be reached at a relatively low cost. There is also agreement among most surveys that showed that interest and awareness levels in consumers increased as a result of informative invoices. A survey did not show any savings at all, after having provided invoices with historic and normative feedback for a period of 18 months. This was an unusual result but it showed one possible cause of lack of results: many of the customers had district heating and it could be that they felt less urged to save than others, since the heating would be available whether they used it or not.

All types of measures help if they trigger consumers to reduce their consumption. Letting households be in control is very important, combined with clear information which is specific to the customer in question. The text says that feedback is necessary, but not always sufficient for savings and awareness. This should not be treated in isolation. The level of savings shows the importance of factors such as housing conditions, personal contact with a confidence-inspiring adviser when necessary, and support from the energy company and the government, which can provide the education and social infrastructure needed to make changes.

Fischer, Corinna. 2007. *Influencing electricity consumption via consumer feedback: a review of experience*. Germany: Freie Universität Berlin. Saving Energy – Just Do It!

Purpose

The text asks what type of feedback is most successful. The author intends to identify the relevant ingredients in feedback that can clarify its efficiency.

Method

The invisibility of electricity means that consumers often do not receive much feedback from their consumption – he does not experience how the warehouse empties and does not perceive that he controls his consumption.

The text discusses a model which mentions a number of *habits* which can be damaging for the environment and which must be broken so that more long-term behaviour can be stimulated. It also mentions a number of aspects related to awareness: you have to be aware of environmental problems, about the relevance of your own behaviour and your ability to change your behaviour. In addition, the text mentions the fact that behaviour standards are relevant here, just as with other, sometimes contradictory motivations (such as comfort or saving money). People evaluate the costs and advantages included in a decision about how they act. The author says that if you think of these categories, you can find out the way in which feedback can operate.

Firstly, feedback can be aimed at electricity consumption, and show the customer the amount of energy used in everyday activities. Habits become subdivided in this way, and it becomes easier for you to reflect about your behaviour and make conscious decisions. Secondly, feedback can awaken awareness in various ways. Feedback can indicate the environmental impact and your own contribution to it. It can also give the consumer a feeling of having control of his behaviour (for example, feedback can let a consumer discover how a certain household appliance, or the way it is used, can influence electricity consumption). Finally, the text covers the way that improved feedback can activate other motivations which stimulate savings: feedback could indicate cost savings that are reached by saving electricity, or stimulate a feeling of competition. Feedback can be combined with other instruments to spur the consumer on further, such as price stimulation, targets or a competition.

Material

The text covers five survey reports and 19 surveys of the results of feedback on electricity consumption and consumers' reactions, attitudes and demands related to this. The reports extend 20 years back in time (1987).

Result

The surveys must be compared with great caution. Firstly, the results were not always presented quantitatively or in enough detail to permit comparisons to be made. Secondly, the surveys used different types of reporting systems.

The author of the text describes a number of components which were found in most of the successful surveys:

- Many feedback alternatives are available to the user through computerised feedback (such as consumption at different periods of time, comparisons, future information such as environmental impact or energy saving tips).
- An interactive element which engages the households – such as computerised feedback or necessary activities such as meter reading.
- Feedback was given more often than once a month (continual, daily load curves or directly after an activity).
- A detailed, specific household appliance analysis.
- Comparisons with previous periods.

These results are not complete, however, since less successful projects have also used the same methods. The only method that was mentioned in the best cases was computerised feedback. For this reason, in a second stage the text authors compare the result of the cases that had used the method with those who had not.

- *frequency*. It was found that the projects that had more than monthly feedback were most successful. It should be added, however, that there were projects with quite poor results among those that had more frequent than monthly feedback. This indicates that frequency is important and can help, but it is not enough by itself.
- *constancy*. There was no indication that long-term projects give better results than short-term ones, but the author says that it is probably sensible to assume that

long-term projects contribute to forming habits and can therefore give more long-term changes.

- *content*. Almost all projects combine consumption and cost information. There no reasons for separating the consequences of both types of information.
- *breakdown*. Reliable data related to efficiency in breaking down household appliances is difficult to find. However, three of the most successful projects show good indications of this type of breakdown. The consumers also appeared to appreciate this mode.
- *medium and presentation mode*. Interactive computerised feedback is highly stimulating. Interactivity and the opportunity to choose involves customers, raises their awareness and allows tailored solutions to be devised. It is less clear how this should be presented, however.
- *comparisons*. Almost all projects use some kind of historical comparison. The author says that this means that it is only interesting to look at normative comparisons by themselves. None of the surveys that used normative comparisons could show any effect on consumption. Whereas the normative approach stimulates heavy consumers to economise, it also tells light consumers that they are doing all right and they can actually upgrade to some extent. These results cancel each other out. Historic feedback meets the same problem: it only stimulates economisation when consumption increases
- *supplementary information and other instruments*. The theory claims that motivation instruments (such as targets, motivation or financial stimulus) and information about saving must be presented to get feedback to work. The utility of information depends entirely on the way it is presented, and whether it is aimed at the group's specific needs.

A general conclusion that can be drawn is that more detailed and frequent feedback, based on actual consumption. This gives consumers a feeling of being in control and

that they are confirmed and well informed by the company. They are also interested in comparisons with their own previous consumption. A number of studies also showed that consumers are interested in being compared normatively and that this would motivate them to saving energy, if it was shown that they consumed more than the average. It was clear that households prefer information that is easy to understand and that they find the current invoices difficult. Easily-understood invoices contain:

- feedback based on actual consumption during a specified period
- clear designations and explanations of the designations, acronyms and technical terms
- clear indications of the various components in the price of energy
- support through graphic presentation which also has clear designations. A pie diagram is preferred for breakdowns. Vertical bar diagrams were popular for comparison with previous periods. Horizontal bars or lines which extend from the lowest to the higher consumer, with different levels of household consumption indicated as data points on the line were preferred for comparison with other households

The text describes that other preferences varied considerably between countries, and probably between cultures. The people of Sweden and the UK were reported to be interested in historical comparisons, but not normative comparisons.

There is probably no perfect type of feedback for everybody. Heavy consumers react differently to light consumers, And middle class groups react different to working class groups. The same thoughts apply to computerised and interactive feedback: a complex aid that demands considerable understanding and initiative from the users. The text authors say that this does not need to be the perfect aid for households with lower education, less technical interest (such as retired persons) or the people with less free time.

Get Smart: Bringing meters into the 21st Century. Energywatch August 2005.

Added nothing new, or was regarded as being not very relevant for the purpose.

Iyer, Maithili, Kempton, Willett, Payne, Christopher. 2006. *Comparison group on bills: Automated, personalized energy information*. Energy and Buildings 38 s. 988-996.

*Purpose*Innovative Billing

"Innovative Billing" aims to provide individualised energy information to energy and gas consumers. The idea is that one, as a customer, should receive an invoice which is individualised by a graph that is supposed to compare your own consumption with other customers. The text consists of two questions: Component 1 describes the type of graph that is most suitable for the purpose and Component 2 discusses the way in which customers are subdivided into groups (called comparison groups). This grouping must be done automatically on the basis of the information available to the energy company, so the aim is also to obtain clarity about the type of breakdown that is most successful.

The idea is that consumers should be stimulated to make successful changes to their energy use.

*Material*Component 1

Personal interviews were held in a first stage, to arrive at the graph that was regarded as being best. After this, four graphs were tested in a large survey. The text compares the two graphs that were understood and were regarded as being best among the respondents in the survey.

Component 2

Ten different grouping modes were compared to find the most successful customer grouping. 115.000 were selected from Portland General Electric (PGE) database, which consists of about 600,000 residential customers.

*Method*Component 1

Two graphs were compared in the text (alternative 1, alternative 2), intending to discover which of the two was most suitable. The graphs describe and exemplify what a finished graph on an invoice should look like. This is done by basing them on the same data, a house with an energy bill of \$80. Alternative 1 consisted of a horizontal bar that illustrated the value scale. Alternative 2 consisted of a horizontal bar on which the house in question was illustrated by a figure and other houses in the same comparison group were also illustrated on it. There was a text for both graphs, which described how you, as a customer, related to the comparison group.

Component 2

They used two criteria when the comparison groups were selected: there should be analytically correct comparisons and customers should perceive them as valid comparisons. Customers were either arranged geographically or by building type to create the comparison groups. This was done so that these types of grouping should be felt to be more understandable and be regarded being as valid. This was an alternative to grouping them by one of the other statistical methods described. The two arrangement modes described, i.e. either breakdown by a geographic method or by building type, are compared and they found that breakdown by building type was closer to hand for energy analysts, with consideration mainly aimed at comparison groups based on floor area, physical design and equipment. Above all, it was emphasised that there are four reasons for considering geographic breakdown. Firstly, customers know what buildings their own house is being compared with, and can also communicate with others in the same comparison group. Secondly, it is

easier for energy companies to obtain this type of data. Thirdly, it was indicated that the same type of houses and social groups tend to be included in a geographic breakdown. And fourthly, it was said to be easier to describe geographic groups to customers. The basic principle was that irrespective of whether geographic or house type groupings were used, the customers in the same comparison group should have their meters read at the same time. This means that houses in the same group that have their meters read at the same time always receive an invoice that refers to the same number of days and same type of weather.

When you look at a group of energy consumers, the distribution is characteristically skewed, which can be seen if you look at the graphic example in alternative 2. There is often a peak just below the mean value, and the heavy consumers then generate a long tail to the right. This is the case, according to the text, no matter how you measure. A group must have the following characteristics, if it is to function well and the customers are to get a good picture of how they correlate with the group: Few deviations and low skewing, which means that the comparison group should consist of similar energy consumers. It must not be the case that large private houses are compared with small apartments.

Result

Component 1

The type of graph that was designated alternative 2 is preferable to the other ones. This is because, as was mentioned previously, the typical energy distribution is skewed so that a small group of heavy consumers generate a long tail to the right. If alternative 1 was used, it is conceivable that the consumers would be deceived and believe that they are on the average and not, as in the example, actually way above the average. Investigations have also shown that alternative 2 is the graph that was preferred by customers and, in addition, was the one that was interpreted correctly.

Component 2

A few of the ten grouping mode that were prepared and compared were found to be more reliable.

The mode that was found to be most reliable was a breakdown by combining building data: Meter reading cycle, type of residence (this means whether it was a single household, large family, or whether it was a mobile or factory-made home), heating fuel (electricity or gas), and by floor area. This type of reading resulted in 777 comparison groups with an average of 94 households in each group. It could be seen in the text that the big disadvantage of this breakdown mode is that the energy company may have difficulty in obtaining the necessary data, which can also entail a large cost

Another comparison group that showed excellent results was breakdown by street address. This breakdown resulted in 3075 comparison groups, with an average of 37 households in each group. However, some streets had far too many households, compared with other streets. This can be rectified, without any noticeable difference, by dividing up the street. It can also be necessary to combine streets to obtain comparison groups of reasonable size. The big advantage of breaking down customers by street address is that the information is always available, and there is no reason to data and it is very seldom that the data is not available. The text authors also assumed that comparisons between neighbourhoods would also encourage electricity consumers to communicate about methods to save energy. One variable that was not included in the survey, but which could provide comparison groups, obtained by street breakdown, an extra dimension – beyond statistical analysis methods.

The other breakdown modes gave less good or poor results.

Meier, Alan. 2007. *How many people actually see the price signal? Quantifying market failures in the end use of energy*. ECEEE 2007 Summer Study • Saving Energy – Just Do It!

Added nothing new, or was regarded as being not very relevant for the purpose.

Morch, Andrei Z, Parsons, John, Kester, Josco C. P. 2007. *Smart electricity metering as an energy efficiency instrument: Comparative analyses of regulation and market conditions in Europe*. ECEEE 2007 Summer Study • Saving Energy – Just Do It!

Added nothing new, or was regarded as being not very relevant for the purpose.

Månadsvis avläsning av elmätare. Slutredovisning av regeringsuppdrag 2002-05-27. Statens Energimyndighet.

Added nothing new, or was regarded as being not very relevant for the purpose.

Pyrko, Jurek, Sernhed, Kerstin, Matsson, Peter. 2000. *Preliminär debitering och mätperiodens längd. Inverkan på elanvändning hos enskilda slutanvändare*. Institutionen för Värme- och Kraftteknik Lunds Tekniska Högskola.

Added nothing new, or was regarded as being not very relevant for the purpose.

Roberts, Simon. 2004. *Consumer Preferences for Improving Energy Consumption Feedback*. Report to Ofgem. Centre for Sustainable Energy.

Material

A series of seven focus groups has been held in different parts of England. (See pages 8-10 for more information).

Purpose

The question is to find the best way to provide feedback information on energy invoices so that their potential is revealed.

Method

The text is based on what the author regards as two clear points: consumers must be consulted when feedback information on their invoices is designed; and energy suppliers have data processing and systems for invoicing that can utilise the different potentials.

The survey used focus group research to find consumers' preferences for feedback information. It also engaged the energy supplier to understand the magnitude of the obstructions they were going to meet when introducing new feedback technologies.

The text was based on previous surveys which showed that:

- feedback is most effective when it is direct, clearly available and specific to the consumer
- consumers appear to be able to understand historic comparison information on invoices
- the presentation mode is a core point which has been very disregarded in the literature
- available proof shows that you can devise much more efficient feedback by engaging the consumers in the design of feedback information and increase the

probability that you create a presentation that meets everybody's preferences for receiving data.

- improved feedback information programmes have been most successful when they were supported by energy advice and other knowledge dissemination activities by the supplier.

Result

The focus groups expressed strong resistance to all types of feedback concept that compared their energy consumption with the average, Other homes like their own, or other homes in the neighbourhood..

They had equally strong preferences for support of simple bar graphs on invoices and comparison of their energy consumption in the latest quarter with the same quarter last year, or all of last year.

In addition to consumption feedback, the focus groups showed interest in improved messages on their invoices related to energy saving and the duty of the supplier to save energy.

Difficulties in including historic consumption data if the customer changes energy supplier are an obstruction to improved feedback.

The text describe possibly the most striking find in the focus groups, which was the agreement among respondents and the clarity of their preferences which were expressed about feedback and improved information. The common find among the respondents can be summed as follows:

- they look at their bills to see what they owe, and if it was estimated
- they are extremely cynical to the motivation behind the energy supplier's advertising for energy saving and they generally distrusted their advice.
- show low motivation to act and great resistance to be nagged and forced to act
- have clear preferences (particularly dislikes) to feedback alternatives

- if they received the right sort of feedback, they would investigate reasons for changes in consumption and can be stimulated to act

Results which show poor reception:

Previous research has indicated that people can be receptive to comparison feedback (*normative*) in which their consumption is compared with similar houses, averages or others in the neighbourhood. But this is NOT the case in this survey. *Concept B* can be mentioned as an example. It received a response that rejected the idea of being compared with an average since this would not be taken seriously. (Please refer to page 14 for more detailed comments on all the concepts.)

Concept C, which compares a person's own consumption with consumption in other homes in the same neighbourhood, did not give better results. Some people answered quickly and positively to seeing that the graph showed that they used less than their neighbours, but the rejected the idea as a generally false comparison, since all the houses are different.

Similar views were expressed about *Concept K*, which compared their own homes with a less energy-efficient house, as a kind of target-based comparison.

Scepticism about the suppliers' ability to provide this type of information was generally found in all groups. This indicates a strong risk that this type of feedback could be rejected as being not valid by consumers, irrespective of how robust the information was.

Image based presentation – Heaps of money or different sizes of houses that represent consumption in different quarters or homes (*alternatives A2 and A3*) were rejected as being superficial or distracting.

Energy-saving newsletters (*Concept F*) were also rejected. Respondents said that they threw this type of supplementary information on invoices away. At the same

time, they said that they were not completely uninterested in the idea, but they did not think that the procedure would arouse their curiosity.

Results which showed good reception :

A strong preference was noted for information that was intended to be put directly on the invoices, compared with simple comparisons of historical data. This could be a comparison both between the same quarter last year (*Concept A1*) or a comparison of the last five quarters (*Concept A4*). All groups wanted to retain *Concept A1*. This was a clear favourite. Some of them wondered about the designations (for example what a kWh was) and the quarter that should be put first (this one or last year's), but otherwise the alternative was regarded as being easy to understand. There was some doubt about whether one actually should react to the graph.

As for *Concept A4*, some respondents showed that they were aware of the need to correct the historic information about temperature differences and price changes. Some indication that such an analysis would come once a year was given, but there was a strong feeling among the participants that it would have to be on the invoice to attract their attention.

The idea of sending an annual report (*Concept E*) containing the above type of feedback was regarded as being potentially helpful. Possibly unavoidably, some people will regard this type of information as junk mail, but there was some interest in receiving consumption feedback in this way, either with the invoice or as a separate component. A large percentage of respondents also expressed interest in information about how electricity is used in your home.

Concepts related to giving more information about energy saving and/or available energy saving services provided by suppliers were generally well received. However, the general cynicism about the suppliers' interest in energy saving and their credibility in giving objective advice coloured some judgements. As an example, energy saving tips and comments on invoices (*Concept 1*) were supported by a freefone number for advice by 4 out of 7 groups. In a similar way, energy advice based on a simple questionnaire (*Concept L*) was regarded as being acceptable by 4 of the 5 groups

where this was tested. However, the respondents preferred the information to come from some body that was independent from the suppliers.

Concept M generated a lot of discussion since it appeared that this concept created a type of feeling that one had missed something. Since the used words like "target" and "offers", it gave a commercial selling feel which made some people suspicious..

Roberts, Simon, Baker, William. 2003. *Towards Effective Energy Information – Improving consumer feedback on energy consumption*. Centre For Sustainable Energy

Purpose

This report and survey intended to answer three questions: What type of information would help to inform customers more about their energy use? In what way can this information be presented to best effect, so that customers gain better understanding and are invited to change their behaviour? What influence would this type of information have on customer's use of energy and choice in the energy market?

Once the above questions have been answered, the goal is to think of a number of testable alternatives, to improve provision and presentation of energy consumption information to customers. They also wanted to give suggestions for a survey method that is based on evaluating customers' reactions to and understanding of the alternatives produced.

The text also wanted to identify the problems connected with the alternatives produced. (This was mainly in the form of availability of data, its quality etc.)

Method

The authors of the text stated that there is a number of techniques for improving information about customers' energy consumption. An analysis of the field found that:

- Feedback is particularly effective when it is direct, clear, available and specific for the customer.
- Consumers appear to be able to understand historic comparison information on bills.
- Consumers report that they are motivated to reduce energy use when they are compared with other groups and councils by using graphs and tables.
- It is possible to create robust comparison groups on the basis of data which is always available. However this mainly applies to comparison groups which have been set up for historic comparison information.
- Consumers must not only be given relevant, engaging feedback from their bills, but also a motivation to why they should react to the information..
- Whereas historic comparison information might motivate them to a certain extent, this is only the case either household consumption increases.
- More effective and inspiring feedback has a greater chance of arriving at a *normative* comparison with similar households, or to be more exact, by setting up goals for reducing consumption.

Initially, eyes were directed at the focus group which was used to design and improve the presentation of comparison information. This was followed up by field survey intended to ensure that clear and unambiguous conclusions can be drawn about the advantages brought by the changes, and why.

The authors of the texts believe that this has a potential to deliver one of the most rigorous and informative surveys so far, related to improvements to customer feedback on invoices.

According to the text, there is a number of sources of potential information related to consumer consumption which can be used to improve the feedback: *Historic consumption information* – comparing the consumer's own consumption from a certain period, with advantage, with the same period last year. *Disaggregated*

consumption information – gives the customer information about consumption in relation to what energy is actually used in the residence. *Time of day cost information* – that allows the customer identify when they might be able to save money by reducing their consumption. *Normative consumption feedback* – supplies the consumer with information which compares their own consumption with either all the other consumers or a selected group with similar characteristics. The text reviews whether one single one of these types of feedback has been shown to have the greatest influence on consumers, through previous research.

The text considers whether there are already energy companies who provide historic consumption information. All of them let the customer have their consumption compared with what their own consumption looked like last year. However, the energy companies used different types of presentation techniques (tables, bar diagram, month by month consumption graphs, only figures, percentage changes). However, the text says that not many of the energy companies had any real explanation for why they had this type of information on the invoice. This is a pity, because the quality of the graphs varies and it would have been good to know what influence they had on consumption.

Result

In order to answer the first question that was mentioned in the purpose section – what sort of information would help to inform customers better about their energy use? -- the research results showed the following conclusions::

- Consumers reacted well to more direct, clearer and more frequent provision of information about their energy consumption.
- Consumers appear to be able to interpret and understand historic consumption information in the right way.
- Consumers indicate that they will be motivated to reduce energy consumption if normative comparison data showed that they were above average in the group

that they regard to be a relevant comparison group (for example a neighbourhood or the same type of household).

- The information must, however, be given in a way that is regarded as right for the consumer to carry out the necessary changes. You can read the following conclusions about this in the text:
- The information should be simple but not facile, with a robust and credible base. (Consumers can misunderstand information which is presented in a too simple manner, if it is not explained).
- The presentation should not involve considerably more paper. (This is regarded as being wasteful).
- Accommodation of text, and diagrams and tables was regarded as being more effective than presentations in only one format.
- Graphic presentations (for example, pie diagrams) were preferred, but text is needed to increase comprehension.

The text says that the following background information is needed in order to get customers to act on the basis of the new invoices:

- Relevant and engaging feedback – justified explanations for measures – a call for action – advice and information.
- Justified explanations for measures must conform with customers' motivation related to "not standing out from the crowd" and "not pay more than I should do". For better feedback information on the electricity bill, these needs can be met through:
- Historical comparison information – *Normative* – comparisons with similar households – offers of assistance to understand the rooms and position – free energy advice.

You can also set up a goal for reducing energy consumption (given the knowledge about the potential difficulty of identifying robust comparison groups).

Historical comparison information – comparisons with percentage reduction goals in consumption – offers of assistance to understand the relative position – free energy advice.

This goal-based approach has a large potential value by giving a *normative* measure for consumption and the same time you avoid the need for comparison groups. The problem with this could be that the consumer regards it as being controlled by the state, and therefore refuses to follow the advice.

The text says that consumers have different ways of understanding and interpreting information. For this reason, feedback is probably most successful if it is presented with visual and verbal components, with an emphasis on graphics, with figures and text used for explanation. It is also important that all conceivable components are carefully tested on focus groups.

Finally, it should also be mentioned that problems may occur on the basis of how we choose to give feedback information to the consumers. For example, it could be that the customer changes from one energy company to another. Then the customer in question will not have any statistics about the amount that this consumer has consumed during previous years. This can be solved by a policy which says that customer statistics are transferred when they change suppliers.

You must also not forget that you have to think of customers with special needs when graphics etc are created.

Robinson, Jennifer. 2007. *Who benefits? The impacts of time-of-use electricity pricing on demographic groups in Ontario, Canada*. ECEEE 2007 Summer Study • Saving Energy – Just Do It!

Added nothing new, or was regarded as being not very relevant for the purpose.

Statistik på räkningen –bättre kontroll för kunden. Slutrapport från projektet för enklare, informativare energiräkningar i Helsingborg. NUTEK, Informationsenheten Gotab, Stockholm 1994

Purpose

The report says that it is aimed at a managing director, invoicing or marketing manager at an energy company which wants to introduce simpler and more informative billing. One of the goals in the project is being to devise an invoice which shows the customer in a simple and informative manner how much energy has been used.

Material

600 selected experimental customers from Helsingborg's Energi's 60,000 customers. A breakdown into four experimental groups was made: large district heating customers, electrically heated private houses, district heating houses and apartments in apartment blocks. The experiment has been tracked and evaluated for a period of one year. The customers saw the new invoices for the first time in October 1992.

Method

The text says that they supplemented the original invoice back pages which contained bar diagrams containing the customers' consumption every month – this year and last year. The table beside the bar diagram also gave the average consumption in equivalent houses.

The following demands were made for construction of the invoice:

- The customer should be able to see their actual consumption month by month.
- The customer should be able to compare themselves with their own consumption in previous years.

- The customer should be able to compare himself with a similar house.
- The routines should be integrated into the debiting system.
- Routines should be within a reasonable economic framework and not lead to materially increased administration

Briefly, the text describes what the contribution to better invoices looked like:

- Integration of consumption and statistics in the existing system
- Bars for consumption month by month – consumption refers to what the customer actually used one year back in time, without climate compensation.
- Comparison with previous years' consumption and what is normal for a similar house – this is presented in table form. The calculation of average consumption is based on the floor area of the house, building type, heating and building year.
- An information letter containing saving tips.
- Debiting by actual consumption.
- Annual statistics for three years – customers receive a summary of all the consumption for the last three years, this is reported in a bar diagram. A special bar shows the consumption compensated for unusually warm or cold days.
- Similar invoices – this is being partly tested in the project.
- A simplified first page with just a subscription charge, consumption and consumption charges..

The authors say that the most important changes in the new invoices are that they had been supplemented by bar diagrams which show the customers' consumption for very month, this year and last year. There are bars for electricity, district heating and water consumption. You can also see consumption information in figures and columns which show the average consumption for a similar house. They say that

having a bar diagram which shows three or five years consumption just causes confusion and is too much information.

The text says that the ideal would have been if the statistics had been compensated, day – by – day, for temperature. But the problem is that there is no method for climate compensation which is not subject to discussion.

Results

The text says that the customers are more satisfied with the new invoices (from 88 to 95%). It has become easier to check and understand. However, customers' knowledge of energy use has not increased and trial groups to have not changed their energy habits. Nor do they have any plans to do so.

The project resulted in making customers generally very positive to the new information. 85% of private house owners are quite or very satisfied with the bar diagram. 70% of the large district heating customers think that bar diagrams are good. 25% are neutral. Apartment customers show greater variation in their judgments. 55% think that bars are good and 40 percent are neutral.

A qualitative survey was done and a couple of interesting comments emerged:

- “ The statistics are good. Diagrams are good. We replaced machinery and you can see this in the electricity consumption. If it increases, you can see it. Then there's something wrong”.
- “The bar diagrams are incredibly good. Also the comparison with similar houses, even if it is difficult to know what is a similar house. You can see how you are doing compared with 1992. We can see if your electricity or water are running away. If district heating runs away, there must be something wrong”.
- “I looked a bit of the diagrams and comparisons with last year. Interesting. Checked that looks sensible. Did not look closer at the tables, but if there are any differences you wonder why. If something looks wrong, you can see it quite simply”.

A table which was also popular was the one for consumption. 78 % of private house and apartment customers thought it was good and only 13 % were neutral.

The bar in which consumption of a similar house was presented was regarded as being very good by 68 percent of private house customers. People have difficulty in understanding the method of calculating a similar house, which caused a number of questions.

24 of 30 customers did not understand how the process evaluation field functioned, but when it was explained in detail, most people were positive to the idea.

As for the energy saving tips on the invoices, few customers noticed the tips but most of them thought that the idea was good (81 percent very or quite good). The conclusion was that saving tips were appreciated by customers, but they must be clearly visible and simple. They must not remind you of advertising.

Uitdenbogerd, Diana, Egmond, Cees, Jonkers, Ruud & Kok, Gerjo. 2007. *Energy-related intervention success factors: a literature review*. ECEEE 2007 Summer Study • Saving Energy – Just Do It!

Added nothing new, or was regarded as being not very relevant for the purpose.

Webber, P, Conway, S, Patel, P & Fleming, M. 2007. *Energy savings from intelligent metering and behavioural change in local and regional public sector buildings*. ECEEE 2007 Summer Study • Saving Energy – Just Do It!

Added nothing new, or was regarded as being not very relevant for the purpose.

Wilhite, Harold, Høivik, Asbjørn & Olsen, Johan-Gjemre. 1999. *Advances in the use of consumption feedback information in energy billing: the experiences of a Norwegian energy utility*.

Purpose

The text was about testing and applying various forms of response information to customers in a Norwegian energy company. The goal was the customers, by receiving response information, should be aware of their energy use, which would thus create a much better platform for energy saving and create better contact between customers and the energy company. The authors said that this is important, since good relations between customers and the energy company are essential for a successful energy company (especially for company like Norway with a completely open energy market).

The text discussed three different types of response information related to electricity invoices. These are *historical* (*Component 1*: section 1 and section II), *normative* (*Component 2*) and *disaggregation feedback* (*Component 3*) the text summarises the process which led to full implementation of historic historical feedback. There are also comments about the other two types of response information and routines related to them.

Material

Component 1

Section I: in 1989, 1,400 households in Oslo and 900 households in Helsinki were selected at random and broken down into a control and three experimental groups. There was no communication between the groups, which was done to avoid changes in behaviour. The project lasted for three years..

Section II: In 1996, a new type of invoice was sent to 2,000 households. The households were all customers from the Stavanger Energi energy company.

Component 2

Different types of graphs mentioned in this section were tested in six focus groups in Norway.

Component 3

About 2,000 households were able to read the results of this survey.

Method

Component 1

Section I: the survey was intended to test the energy saving potential of *Historical feedback information* in Oslo and Helsinki. This was done by giving the customers the graph on invoices which compared this year's consumption with last year's consumption, every 60 days. One of experimental groups was also given energy saving tips as a compliment to the graph. The electric consumption was checked during the survey period. A questionnaire and telephone interviews were used on respondents from all groups.

Section II: 2000 households received a new type of invoice in 1996, containing graphics (Figure 1) which was based on information from the project in this text, designated as "Section 1". Invoices were sent every 60 days. The informational in the graph was based on the participants reading their meters themselves and sending the results in.

Component 2

Normative feedback is defined as follows: information which gives the receiver the ability to compare their own energy consumption with others, under the same circumstances.

The project is intended to answer five questions: Are customers interested in this sort of feedback? Is the information useful? Does it increase awareness? What problems and difficulties are there, related to programming and production? Would it be worth the difficulty of providing the information on a larger scale?

The project basically uses the same approach as an American model which is based on comparing neighbourhoods. Although this model doesn't make any distinction between building types and size of families, for example. This project was based on

breaking down customers by means of five different variables instead. They were as follows:

- number of people in the household
- type of building (private house, apartment in small building, apartment in large building)
- floor area in square metres
- type of heating (fully electric, mix of electric and other, not electric)
- hot water (included or not included in the electricity bill)

This type of breakdown was justified by the feeling that the comparisons made in this way would be seen as more legitimate by customers. This was in relation to the American model mentioned. They said the customers would otherwise be able to explain away differences in the graphs since there are differences in building types and so on. *The graphs are based on information which is obtained from a questionnaire which is sent to customers.*

This project tested three different graph types on focus groups. Graph type number one (or alternative 1 and figure 2) is a linear version which places the customers' consumption in relation to the customers with the highest and lowest energy consumption in one in the same group. Graph type number 2 (alternative 2 and figure 3) puts the customers on a curve which shows the distribution of other households and where they are placed on the curve, this is also all in one and the same group. The third graph type (figure 4) is in many respects the same type of curve as is used in the American model. The curve consists here of small houses.

Component 3

Disaggregation-feedback means that you make the amount of energy used and what is used for in the residence visible to the customer. According to the authors of the text, there is a general misunderstanding about the things which use the most electricity in the home. *This type of graph is also based on information which is sent*

in manually by the customer. They tested two types of graph for the purpose, one was a bar diagram and the other was a pie diagram (figure 5). The pie diagram was given far more votes on its side by the test groups.

Based on the tests, they arrived at six different types of ingredients that should be put into the pie diagram: electric heating, other heating, hot water, lighting, white goods and others.

Result

Component 1

Section I: in the first year, it was found that the experimental groups saved an average of 10 percent in relation to the control group. Something which was to remain during all three years the project lasted. The group which received the invoice with both graphics and energy-saving advice saved almost five percent. The test also led to customers reading their bills more often, they also found them more easy to understand and many people gained a better idea of development trends in consumption.

Section II: According to the text, the respondents' responses to the new invoice and its graphics were generally good. Energy savings could also be reported. Among other things, the number of customers who cut their room temperature at night or when they went away for the weekend increased.

Developments in section II: After the trial period described in "Section II", the energy company continued to send the same time of invoice with associated graphics. Eventually almost the entire customer database were able to receive the new invoice. They returned in 1998 with a new questionnaire to the 2000 customers who took part in the project in the beginning. The survey showed that the participants' electricity consumption had fallen by 4% during the last two years whereas total electricity consumption in the country had increased by 4%.

The authors of the text write that the graph type described in *component 1* has a higher potential for energy-saving in a country like Norway. This is primarily, because there are so many in Norway who have Electric heating.

Component 2

According to the text, the participants in the focus groups did not think that graph type 3 was good. Some thought that the model was childish. Others were not sure whether it was so that each house symbolised one or a larger number of neighbours. For this reason, they chose not to continue investigations of this graph.

Alternative 1 and alternative were regarded as having many advantages and disadvantages, and were regarded as being more less equally good. Based on the focus groups view of the matter, it was decided that the alternatives would be tested on a greater scale. The result of this was the people were quite interested in the information. Only a few people found it useless or uninteresting.

The authors of the text think that the fact that only 16 percent of respondents found alternative 2 to be difficult to understand was a surprising result, considering that the curve was so refined. Alternative 1 was also understood by many people, in fact somewhat more compared with alternative 2. In particular, people aged over 60 had difficulty in understanding alternative 2.

The text describes how the customers who participated in the survey had expressed that they might feel motivated to cut their electric consumption if they found that they were above the average.

As for the question of whether alternative one or alternative 2 should be used, they wrote that the level of interest was more less equal between them. However, they could see that understanding was somewhat higher for alternative one. Since the cost of producing and programming alternative one is lower, it was thought to be a natural decision to choose this graph.

Component 3

The text stated that customers were very interested in this type of graphics. A very small number of people in the survey had difficulty in understanding the graph. People over 60 and people with less than nine years of school education were overrepresented among people who did not understand the graph.

Components 1,2,3

Historical, normative and disaggregation feedback. All three types were found to be highly regarded by customers. They influenced all customers' energy consumption – both as regards awareness and knowledge about it. Historic feedback has definitely led to energy savings, and the other two types show promise in doing this.

Wood, g, Newborough, M. 2002. *Dynamic energy-consumption indicators for domestic appliances: environment, behaviour and design*. Scotland: School of Engineering and Physical Sciences.

Purpose

Understanding of the interaction (interface) between people and the equipment they use is needed to improve awareness of energy use.

Interesting thoughts and background information.

The text says that feedback has three main functions:

- Feedback has a teaching function – people learn about the way that consumption activities interact with the amount of energy they use.
- Information about habits – people use what they have learned and can develop a change in routines.
- Internalisation of behaviour – when people develop new habits after they have changed their attitude to suit the new behaviour..

The text mentions that there is research that says that energy information in written format, as on invoices, is not the ideal solution for reducing energy consumption (in the UK). Mainly because this can exclude a large proportion of the population (about 20 percent of the adult population in the UK have difficulties with basic reading and mathematics). The authors say that feedback in the form of frequent mailings of invoices or energy inspections is not effective. This is because consumers do not know the relative cost of each energy-using system in their households. This can be compared with the shop that has not marked the price of each good and only presents the grand total at the checkout. The appliance based feedback described in the text could distinguish itself from paper-based feedback so that it is done during the time and directly after people have done some form of energy consuming task. The procedure also differs in that the information could be displayed on the appliance.

The text says that people's perception and cognition is involved when you use a display in the way described above. The authors say that literature which is available about feedback is not clear about the best way to provide feedback in the home and several questions remain: how often should feedback information be provided? In what format should the information be presented (for example numbers, graphic, energy / costs / CO₂ data)? Should feedback be presented centrally or on final use? The text says that there is a conclusion which says that electronic rather than paper-based feedback is the most promising method of disseminating information about energy use. However not much has been published about the way that continual electronic information should be presented – especially as regards individual household appliances.