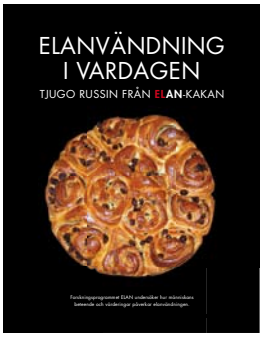
ELECTRICITY USE IN THE HOME

TWENTY WAYS TO SAVE

The Swedish version of this brochure was published with the cover as shown below.



ELAN
PROGRAMMET

THE ELAN PROGRAMME

Various stages of the ELAN programme, which has been running since 1998, have investigated how the habits and value judgements of individuals affect their use of energy. The programme provides a forum for investigation and discussion of behaviours and energy use, constituting a focus point for energy utilities, research scientists, public authorities and consumers to improve their knowledge of these aspects. Both short-term and long-term matters of interest are covered, in a border zone between social science, technical and economic research.

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Further information on the ELAN programme can be found at www.elanprogram.nu

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FROM THE ELAN INVESTIGATION – THE MAIN POINTS

How can we encourage consumers to improve their efficiency of domestic energy use? What are their experiences of meter replacements? Do consumers accept demand management? How can we best show consumers how much electricity they are using? Is information and communication equipment becoming the largest user of domestic electricity?

There are many fascinating and important questions concerning how the behaviour and value judgements of users affect their use of electricity, and the ELAN research programme has now provided answers to some of them. This report presents a collation of results from ELAN, of real application for all those involved in various ways in the use of energy. The purpose of the report is to provide a concise source of overall information on the results of the ELAN programme in the fields of domestic heating, communication, electrical appliances and the benefits of hourly metering.

A few minutes well spent, hopefully encouraging further individual conclusions.

Monika Adsten
Swedish Electrical Utilities
R&D Company, Elforsk
Programme Manager
The ELAN programme

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Göteborg Energi
Chairman
The ELAN programme

Further information is available in the form of research reports that can be downloaded from www.elanprogram.nu. The site also contains video film presentations of the results from most of the projects.

GENERATION CHANGE IN 30 % OF SWEDEN'S DETACHED HOUSES PROVIDES OPPORTUNITIES FOR IMPROVING THE EFFICIENCY

Detached houses built between the latter half of the 1960s and up to the 1980s are facing a generation change: within the next few years, many of them will change hands. Most of the houses from this period are relatively large, with about 700 000 of them still needing considerable improvements in their efficiency of energy use in such ways as replacing heating systems and improving the performance of building envelopes. About half of them have electric heating as their sole heating source.

New owners make changes

New generations buying older detached houses often carry out substantial conversions, modify floor plans, extend living areas, replace kitchens, insulate the structure and complement electric heating by heat pumps. However, improvements to the building envelope, such as replacement of windows, applying additional thermal insulation or changing to more energy-efficient heating systems, are often postponed. Houses from the 1970s and 1980s are now welcoming new and younger owners. Houses from this period use a lot of electricity for heating, and so replacement of, or additions to, the heating system, together with improvements in the building envelope, are important ways of improving the efficiency of energy use.

Decisions by many house owners

There are many hundreds of thousands of house-owning families faced with the need to make improvement decisions, whether relating to the building envelope or to the heating system. Energy advice on building envelopes and heating systems, in order to improve thermal comfort in an energy-efficient manner and to reduce energy costs, is important. Good advice and experience will be listened to, particularly if it comes from neighbours or friends. There is a considerable unsatisfied demand for both personal and professional advisory services.

Major improvements in apartment buildings too

Although the number of owners of apartment buildings is relatively small, the actual number of buildings and apartments belonging to them is substantial. About 80 % of all apartment buildings have district heating. Those built before 1960 have now mostly been converted, with small apartments merged to produce larger ones, windows replaced and the building envelope in general upgraded. Over the next few years, it will be the turn of all the apartments built during the 1960s, 1970s and 1980s, with particular attention being paid to those from the country's Million New Homes programme from the 1960s and 1970s.

FURTHER READING:
Anna-Lisa Lindén, Elforsk report no. 07:61

2 DISSATISFACTION TRIGGERS, NEIGHBOURS AND POLICY MEASURES PLAY THEIR PART WHEN DECIDING ON ACTIONS

Drilling boreholes for a ground heat source heat pump for a typical house from the 1970s having waterborne electric heating.

Some form of dissatisfaction with present conditions is usually needed in order to prompt a house-owner to decide on long-term investments in new heating systems or improvements to the building's building envelope. Dissatisfaction turns thoughts to new ideas and a receptiveness for change, in turn providing an opportunity for input of information on alternatives. Information from neighbours is valuable, although economic incentives and policy measures can also help to crystallise a decision.

Grants assist energy improvement measures

Although economic policy measures alone may not lead to decisions, they do accelerate the decision-making process and can result in house-owners choosing a more energy-efficient solution than they had originally considered, or more extensive improvements. Energy-improvement grants can, for example, result in the fitting of more energy-efficient windows when replacing old windows than had originally been intended.

Informative material in the form of advertisements and various types of information material accelerate the decision-making process. Information from neighbours, too, can play a part: the value of such input, particularly in residential areas with many similar houses and a good sense of community, should not be overlooked.

The age of the house and its type of heating system are decisive in deciding whether an improvement will be made. The necessary incentive to start the process can be provided by the condition of the building envelope (facades and windows), the condition or performance of the heating system, or whether costs have reached the point that they must be reduced. As far as simple and relatively cheap improvement measures, such as draught-proofing windows or applying additional insulation in roof spaces are concerned, only a simpler impetus is required.

FURTHER READING:
Erika Jörgensen, Elforsk report no. 09:41

3 ESTABLISHING WARMTH AND COMFORT IN PASSIVE HOUSES REQUIRES NEW HABITS, BUT OCCUPANTS QUICKLY ADJUST

It's no more complicated to live in a passive house than in an 'ordinary house', although occupants normally need to learn how to maintain comfortable indoor conditions at first. The occupants of the Lindås passive houses quickly learned how to control the technologies, despite the fact they had not necessarily chosen the houses on the basis of their low environmental impact.

Neighbours involved at first

Conversations between new neighbours in the Lindås houses initially involved a common interest in the houses' technology and how to achieve and maintain comfortable conditions. However, once they understood the technology and had created comfortable conditions, interest in the energy technology had played its part and was no longer needed.

Different energy demands in similar houses having the same energy concepts

Occupants' ideas of thermal comfort, the resources available and how they are used, all play a considerable part in determining energy use. Energy demand in some of the Lindås terrace houses is considerably higher than had been expected in the design stage, which can partly be explained by higher indoor temperatures than had been assumed. In addition to using the heating system to control temperatures, heating is contributed by electrical equipment, lighting or by purchasing additional electric heaters. Good thermal comfort can also be obtained by appropriate use of carpets, thicker clothing or slippers.

The occupants are not worried by the fact that their energy use is higher than expected, as they realise that they are still using considerably less energy than they would in an ordinary terrace house.

In the case of households in which the members are seldom home, where there are only a few occupants, it can be more difficult to achieve the required indoor temperatures.

20 terrace houses using passive house technology have been built in Lindås. They have no conventional active heating systems, with most of the heating being provided passively from the occupants' body heat, by surplus energy from various domestic appliances and by insolation.

A 'warm and comfortable' washing machine

Waste heat from the use of domestic appliances is one of the sources of heat – an application with which they have not previously been associated. Domestic appliances have acquired an additional duty of providing warmth. Washing machines, for example, don't just do the laundry, but are also regarded as 'warm and comfortable' in the passive houses.

Do the houses encourage electricity saving?

The Lindås houses show that, using energy-efficient and energy-conserving technology, it is possible to encourage occupants to use less energy and resources. However, if indoor temperatures are lower than desired, the incentive to conserve electricity is reduced, as domestic appliances make a noticeable contribution to indoor warmth.

FURTHER READING:
Charlotta Isaksson, Elforsk report no. 09:98

4 METER REPLACEMENT: A LOT OF WORK FOR THE UTILITIES BUT NO BIG DEAL FOR CONSUMERS

The new requirements for monthly meter readings for all electricity customers have meant that the electricity network companies have installed remote-reading meters for all their customers. This has involved a lot of work for the sector, particularly in informing customers on what is happening. However, customers have no particular expectations of the new meters.

Few expectations

Customers knew that their meters were to be changed, but few understood why. They have not had any expectations on what benefits the new meters might offer.

The long-term aims of the authorities' requirements for monthly meter readings are that invoices should become clearer and that customers should therefore become more aware of the amount of energy that they use, reducing it in the longer term. However, the decisive factor in determining customers' ability to understand and become involved in their own use of energy will depend on how the energy companies use the information from the meter readings. This is an area in which there is still considerable potential for development by the industry.

Clear communication is vital

Many customers had mistakenly expected that monthly metering would result in more uniform invoices, i.e. with no peaks during the year. Others have also misunderstood the information that they will now be paying for 'actual use', suspecting that this indicates that they had previously been misled into paying for something other than what they actually used.

Tips for good presentation of information:

- Start from the customer's interests, needs and knowledge
- Don't think about the technical features – think about what's good for the customer
- Find other ways of describing energy use apart from the basic kWh
- Build up good relationships with customers
- Be clear in communication
- Create trust and confidence

Local links provide better customer contact

Several investigations carried out as part of the ELAN* framework indicate that smaller electricity companies, or those having strong local links, find it easier to establish contact, loyalty and trust. The same picture is presented by the annual survey conducted by the Swedish member of the international Extended Performance Satisfaction Index organisation (EPSI), which conducts consumer satisfaction surveys in about a score of countries.

FURTHER READING:

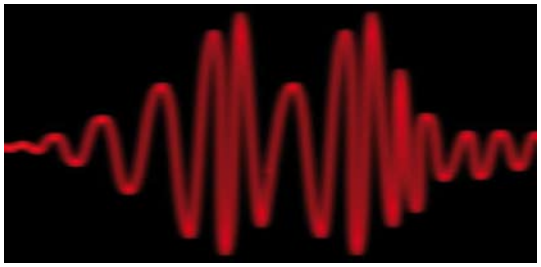
Karin Mårdsjö Blume och Inger Lindstedt, Elforsk report no. 08:75
Inger Lindstedt och Karin Mårdsjö Blume, Elforsk report no. 08:76
Inger Lindstedt, Karin Mårdsjö Blume, Christel Brost, Elforsk report no. 09:58

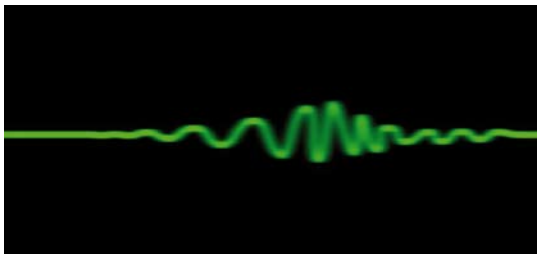
***Inger Lindstedt och Karin Mårdsjö Blume, Elforsk report no. 08:76**
***Jurek Pyrko, Elforsk report no. 09:90**
***Åsa Thelander, Elforsk report no. 09:08**

5 KEEP DESIGN SIMPLE

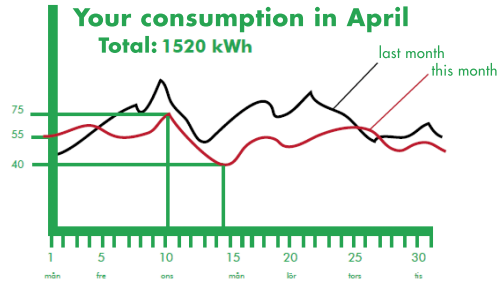
If information on consumers' own electricity use is to work on a broad front, it must be simple. Clear diagrams, or bar graphs, in combination with appropriate colour symbols for clarification, work best.

Many different ways of visualising electricity use have been developed and tested in ELAN projects. Although these projects have often had ambitious aims of delivering detailed information for various time intervals, expressed in terms of energy, money or environmental impact, users have tended to prefer simple information. Projects that have been running for longer have changed from sophisticated design to simpler design.

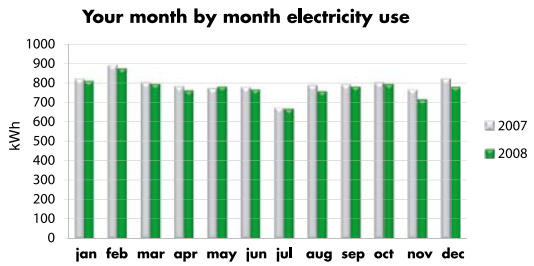




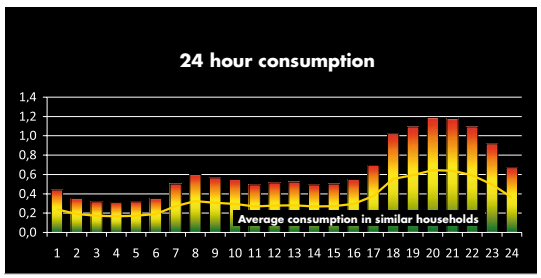
Representations of low and high energy use at home. This is a proposal for a screen saver for a mobile phone.



How energy use might be shown on a bill, indicating minimum and maximum demands, in comparison with the previous month.



Month-by-month energy use over a year in comparison with that of the previous year. This is an example from an invoice, but it also works well when presented in other ways.



Hour-by-hour energy use during one day. This household is showing high consumption, which can be seen by comparison with the average for similar households (the yellow curve). The high and low values are indicated by red-yellow-green - a colour symbolism recognised by everyone. This is an example from a display.

FURTHER READING:

Cajsa Bartusch, Elforsk report no. 09:38
Magnus Bång och Frida Birkelöf, Elforsk report no. 08:25
Tim Hallin, Inger Lindstedt, Tove Svensson, Elforsk report no. 07:44.

6 INFORMATION NEEDS TO BE DELIVERED IN VARIOUS WAYS

When presenting information on electricity use to consumers, we need to think about both the information channel to be used and how the information is to be presented. Should information be provided only for those consumers who ask for it, or should it be sent to all of them? Should it be provided as soon as possible, without time delay, or in connection with billing? It may be necessary to use several different information channels if consumers are properly to grasp details of their electricity use.

Image: Interactive Institute

The Energy AWARE Clock provides a display of the household's current and historic electricity use, indicated by the clock's dynamic hands. Current electricity use can be related to the previous minute, hour, day, month or year.

Visualisation of electricity use

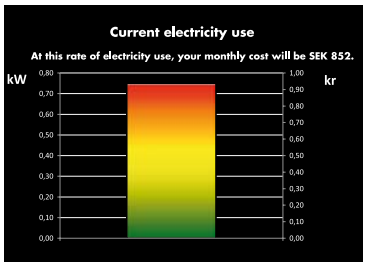
Three tools for providing information on electricity use have been developed and tested for a longer period of time on residents in apartment buildings:

Wireless display: Provides direct information, with no time delay. With sufficiently high time resolution, this makes it feasible to estimate the amount of electricity being used by different appliances. An example is the Energy Aware Clock, known as the engineer's display (see right), or a mobile phone.

Graphic information on electricity bills: Provides information over a longer period of time. The major benefit of this method is that it reaches virtually all households, and so simplicity and ease of understanding are particularly important. This should also include the aim of reaching even those who do not understand Swedish. Displaying energy use on a month-by-month basis has the advantage of being in step with the billing frequency.

Web-based statistics via computer: This provides both direct information and monitoring over a longer period of time. Having to use a computer to find out details of electricity use is an active choice, driven either by clear interest or for some specific purpose. This means that users are more receptive, so that simplicity and easy availability are, in turn, less important. The main benefit of this method of presentation is that users can choose the time periods and comparison information to suit their needs and requirements.

The results show that all of these methods contribute to greater awareness of electricity use. None of them has stood out as being more suitable than any of the others: instead, they complement each other.



'The engineer's display' shows individual electricity use on a screen. This display shows present instantaneous power demand.

Information tools must be available when necessary

Nothing in the ELAN investigations indicates that consumers need good oversight of their electricity use at all times. Different means of delivering information can be used intensively over shorter periods in order to provide consumers with sufficient information. When designing information tools, it is important to bear in mind that most users are, in principle, new to the information or system each time.

FURTHER READING:

Cajsa Bartusch, Elforsk reports nos. 08:18 and 09:38

EASIER TO COMPARE WITH YOUR OWN DATA THAN WITH OTHERS'

If consumers are to be able to understand visualisation of their electricity usage, it needs to be shown together with some form of absolute level, so that consumers can then see whether their usage is high or low. Ideally, consumers want to be able to see their electricity use both in comparison with their previous use and in comparison with that of other persons.

Comparing the consumer's present and earlier use

When making comparisons with a consumer's earlier use of electricity, the time element is an important part. How far back in time should the comparison be made, and in what way should the information be broken down? Admittedly, a monthly breakdown provides plenty of figures and columns for the consumer to grasp, and ought not to be a problem if it's accompanied by a carefully designed graph. Comparison with the previous month has the advantage that the consumer can remember changes and note their effects.

In order to show how electricity use is affected by other seasonal activities, it can be worthwhile comparing the amount with that of the same month in earlier years. However, if some of the electricity is used for heating, consumers may distrust or misinterpret information, as weather conditions differ from one year to another, and there does not at present seem to be any foolproof way of allowing for this.

Comparison with other electricity users

A couple of common comparison groups are those of the supplier's other customers, or average values of electricity use in Swedish households. However, simplistic comparisons with other electricity users can be misleading, as it is difficult to find representative groups for comparison with each individual consumer. Electricity used by a household with a large number of children, for example, can appear to be very high when simply compared with others, even though it is actually low in comparison with other families with children.

Aiming for targets is easier when based on self-comparison

Aiming for consumption targets is based on the energy company or the consumer setting targets for electricity use, based on the consumer's own starting conditions.

Comparing one's own figures has the advantage of avoiding problems in finding comparable comparison groups. In addition, when comparing figures with groups, there is a risk that those who are better than average regard this as satisfactory and continue with their existing patterns of use.

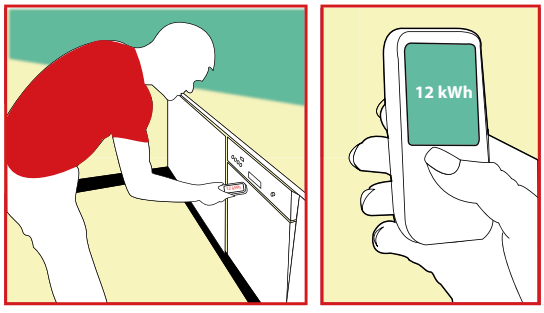
FURTHER READING:

Cajsa Bartusch, Elforsk report no. 09:38
Tim Hallin, Inger Lindstedt, Tove Svensson, Elforsk report no. 07:44

8 CONSUMERS WANT TO SEE HOW THEIR INDIVIDUAL APPLIANCES USE ELECTRICITY

Consumers need to see and understand the electricity being used by different appliances. They're keen to see whether a new appliance, or a change in habits, affects the amount of electricity used.

The hourly metering values for a household's entire electricity use cannot distinguish the effects or patterns of individual appliances, or register the effects of small brief changes. Nevertheless, some households have managed to use this information in order to draw conclusions. Several of the ELAN projects have shown a clear wish on the part of consumers to be able to understand the amount of energy used by different appliances. When all's said and done, this information could be that which gives the best results in producing more aware, and thus more efficient, patterns of energy use. This is an area in which there is considerable potential for developing new products and services.

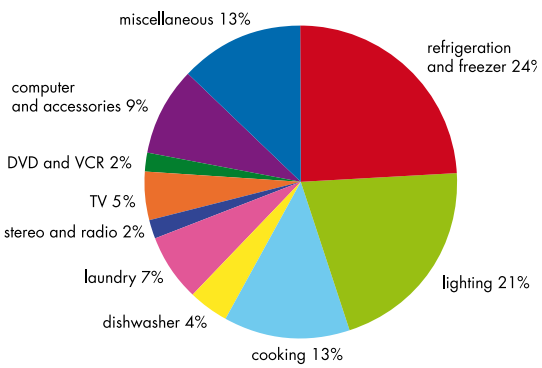


A consumer request: Displaying how much electricity the dishwasher uses on a mobile phone.

New calculation model can facilitate a breakdown of electricity use

Using time data that describes the daily patterns of the members of a household, it is possible to produce a detailed profile of electricity use throughout the day with the help of a newly developed model* that can produce a visualisation of what electricity is used for and when it is used.

Detailed electricity use profiles are needed in energy calculation programmes, for such purposes as investigation of the effects of changing behavioural patterns, when developing new control functions for appliances, or for matching demand to availability of solar electricity.



Breakdown of electricity use, by purpose, in an average apartment household

FURTHER READING:

Cajsa Bartusch, Elforsk report no. 09:38
Jurek Pyrko, Elforsk report no. 09:90
Magnus Bång och Frida Birkelöf, Elforsk report no. 08:25
Tim Hallin, Inger Lindstedt, Tove Svensson, Elforsk report no. 07:44
Inger Lindstedt och Karin Mårdsjö Blume, Elforsk report no. 08:76

***Joakim Widén, Elforsk report no. 08:54**

9 PUTTING IT ON A MOBILE: IT'S NOT JUST AN ALARM CLOCK

Mobile phone applications have considerable potential as information channels for individual electricity use, both in terms of direct information and of seeing changes over a longer period of time. It's difficult to say what possibilities might be offered in the near future, other than that we can be sure that there will be many. ELAN test groups have put forward many creative ideas for development. The Visual Wattch project has tried out the use of mobile phones as alarms for high electricity use, or to indicate when the price of electricity is low, as well as for use as information channels in the event of power failures.

Use of a mobile phone to provide interactive information on a consumer's own use of electricity has been studied, with the aim of investigating the feasibility of using the mobile phone as a means of modifying consumer behaviour to improve the efficiency of energy use. Surveys have shown that consumers favour simple mobile services: easy to understand, visualising personal energy use, providing notification of problems or departures from normal patterns, and providing information in the event of power failures. If these services were available, mobile phone users say that they would be prepared to pay for them.

eChat is an example of a service by which electricity companies can communicate directly with their customers via their mobile phones. It provides up-to-date information on a household's use of electricity, information on power failures, and other relevant information such as electricity prices or energy-saving advice.

FURTHER READING:

Magnus Bång och Frida Birkelöf, Elforsk report no. 08:25

10 "ELECTRICITY DOESN'T EXIST"

Electricity and energy are a long way down most consumers' agendas. How can we increase their awareness and involvement? Without specific participation, energy consumers are unlikely to understand the link between their own behaviour and their use of energy. How should an information campaign be structured?

It's OK not to understand
A lack of knowledge of electricity, energy or associated aspects is not a stigma in our society. Most consumers regard bills from energy companies as incomprehensible, and that it's perfectly normal not to understand them.

Understanding is the key to changing behaviour
Metered values can help to increase understanding, but we need a new means of information to get the information over. Many consumers don't understand what 1 kWh means, and nor can they calculate how much energy some device uses or whether it would pay them to use a less energy-intensive alternative. This is an area in which communications need to be further developed, together with new ways of showing consumers just how much electricity their different appliances are using.

How to arouse interest?
Design students at Malmö University were asked to create an information campaign to stimulate interest and arouse curiosity about electricity and energy. The campaign started with advertisements in the city, which were followed by a brochure on the same theme that was delivered to consumers. The students used confrontational claims, such as Electricity doesn't exist and kWh is a myth, in order to grab attention and to be provocative.

FURTHER READING:

Christel Brost och Inger Lindstedt, Elforsk report no. 09:57
Inger Lindstedt, Karin Mårdsjö Blume och Christel Brost, Elforsk report no. 09:58

NO SIMPLE RELATIONSHIP BETWEEN IMPROVED STATISTICAL INFORMATION AND CHANGES IN ELECTRICITY USE

Information to users on their own use of electricity doesn't automatically result in a reduction in that use. An investigation into the effect of three companies' web-based statistics service was unable to find any clear indications of changes.


Image: Siemens

Several electricity suppliers now offer web-based statistics services that can provide consumers with graphical information on their use of electricity, with the aim of domestic users being able to obtain more details, and a better understanding, of their use of electricity. In order to investigate whether these statistics services had any effect on households' patterns of electricity use, the periods before and after introduction of three of these services were analysed.

The results show that it is impossible to decide whether statistics services result in a reduction or an increase in electricity use. A high degree of interest and engagement is needed if households are to reduce their use of electricity, and in such cases the provision of statistics can be of good help.

Use of the service

Less than half the number of households with access to such a service have actually used it. Those households that do use the service have a higher energy awareness and better knowledge of their electricity use. The main reason for not using the services is given as lack of time, although the quality of the website can also influence use.

Want to check

Most of the households using the service do so in order to check their electricity use: they want to know how much electricity they're using and to compare it between different time periods (months, weeks, days or hours).

Opportunities for the development of new services

The survey found that some households put the information to further use: for example, checking how much electricity that various appliances took, or to check the effects of some change in habits or implementation of an improvement measure.

FURTHER READING:
Jurek Pyrko, Elforsk report no. 09:90

12 THE GENERATION DIVIDE AFFECTS THE WAY OF BUYING AND USING ELECTRICAL EQUIPMENT

Those who have grown up over the same period of time and in the same culture have experienced the same spirit of the times and been influenced by the same events. The first 20 years of an individual's life tend to set the reference standard for impressions and experiences later in life. The generation divide is a significant factor in explaining differences in consumption behaviour. As far as energy use and the possession of electrical equipment are concerned, there are substantial differences in the conditions experienced by the generations in Sweden today as they grew up.

The older generation spends the very least on goods, which is not surprising as they grew up in, and were young adults in, a society in which many of these items were unknown. The record generation spends more on radios, stereos, CDs and MP3 players, which could mean that they're willing to buy expensive items. Alternatively, their higher spending on music equipment could be interpreted as indicating a wish to link to their earlier years through music when the children have flown the nest. Generation X spends more on radios and DVDs, which can be due to the fact that many of them have small children. The MeWe generation buys more games etc. than does other generations, as games tend to be designed to appeal to this particular generation.

Younger generations spend more on electrical equipment but use it less

The MeWe generation consists of today's young adults, whose consumption aspirations will leave their mark on society for a long time into the future. They spend considerable amounts on items that use electricity, particularly those connected with information or entertainment, such as computers and televisions. The fact that the MeWe generation uses so little electricity in comparison with other generations is probably due to the fact that they

Born	Generation name	Characteristics	Per-capita electricity use	Expenditure on electrical equipment
1920s and 1930s	The older generation	Hard workers, law and order, conformity, patience, honour and sacrifice	4100 kWh/year	SEK 2450/year
1940s and 1950s	The record generation	igh numbers, well off, influential, IT-aware and self-aware	3300 kWh/year	SEK 3100/year
1960s and 1970s	Generation X	Self-reliant, globalism, see work as a way of life, put creativity before productivity, uninterested in 'isms' of various types or prioritising equality	2440 kWh/year	SEK 3020/year
1980s and 1990s	MeWe	Nintendo generation, with strong belief in own future, greater than their confidence in the future of society. For both sexes, the ideal society emphasises a healthy nature, environmentally-aware companies and pristine wilderness	1340 kWh/year	SEK 4060/year


Image: Siemens


Image Siemens


Image: Siemens

are still mostly living in small apartments.

The older generation use twelve times as much electricity as they did 50 years ago, but spend about the same on buying electrical equipment as then

During their lives, the older generation have seen major changes in consumption patterns and energy use. Their consumption habits have been affected both by the times in which they grew up and by the major improvement in welfare over these years. They represent, in other words, a good picture of how consumption can change as a result of the times through which we are living. The amount of electricity used by the older generation has increased by a factor of twelve, even though that electrical equipment is more efficient and uses less electricity. This can be explained by the fact that the number of items that they own has increased, and that many homes are nowadays heated by electricity. If converted to 2004 equivalents, expenditure on electrical equipment has not changed noticeably. One difference, however, is that the same amount of money now buys much more advanced equipment than was the case a few decades ago. A small washing machine, for example, would have cost over SEK 7800 (in present-day terms) in 1958, as against a price today of about SEK 5000, and also with far more features.

Differences between urban and rural areas has disappeared

A survey into purchases over the period 2003-2005 found little difference between residents in urban areas and those in rural areas. This should be compared with the results of the same survey in 1985, which found several differences: households in urban areas spent more on entertainment and information equipment, such as video recorders, computers and televisions, and they also bought more equipment for care and cleaning, than did those living in smaller towns or in rural areas.

FURTHER READING:

Annika Carlsson-Kanyama och Ann-Sofie Stenérus, Elforsk report no. 08:23

13 INFORMATION AND ENTERTAINMENT EQUIPMENT TAKING A GREATER PROPORTION OF DOMESTIC ELECTRICITY

Domestic households are increasingly well equipped with computers, games players, televisions, CD players, video recorders, mobile phones etc. Today, entertainment and information equipment accounts for 20 % of domestic electricity use, and could rise to getting on for 50 % in the future. The trend towards individualisation means that a growing number of family members are acquiring their own items of equipment.

Consolidating the information society and reducing the amount of energy that we use are two matters of importance, high on society's agenda. They can be seen as contradictory, as the increasing use of information and communication technology (ICT) requires a growing quantity of energy to produce, use and finally dispose of the equipment.

The personal trend contributes to individual ICT use by family members, requiring a growing number of items of equipment and longer usage times. Children and youngsters have growing amounts of ICT equipment in their own rooms. Taken as a whole, parents' control of the amount of use of such equipment, particularly by youngsters, does not seem to be particularly marked or systematic.

Boys in the family?

Factors that affect the purchase of video games include belonging to a young generation, having boys in the family, being single fathers with children, and having children in the 6-12 age group.

Difficult to influence stand-by energy

The use of electricity by equipment when it is in use is important, but is also important in the stand-by mode, both in purely technical terms and in terms of user behaviour. Habits and routines are a main cause, although leaving equipment on stand-by is also affected by convenience, design problems, lack of awareness and little environmental awareness. Convenience can be expressed as a 'good enough' state of mind, i.e. the person concerned knows that the equipment ought to be turned off, but feels that it is sufficient just to go to the stand-by mode.

When developing new equipment, intended to use less energy, consideration needs to be given both to the amount of energy used in the stand-by mode and to new designs and technologies for switching off the equipment. This needs closer links between domestic users, product developers, politicians and energy experts, which is the purpose of the new European Eco-Design Directive for electrical equipment.


Image: Samsung

Risk of rebound effects

There is a risk of what are known as rebound effects, i.e. all the savings of time, energy and money that can be delivered by ICT are simply used for more ICT use or for other energy-demanding activities. Communication equipment, for example, had been expected to reduce the amount of transport, but surveys have shown that the result is the opposite.

FURTHER READING:

Kristina Karlsson och Eva K Törnqvist, Elforsk report no. 09:86
Annika Carlsson-Kanyama och Ann-Sofie Stenérus, Elforsk report no. 08:23

4 RELIABILITY IS THE KEY FOR BOTH BUYERS AND SELLERS OF ELECTRICAL EQUIPMENT

It's not just the amount of energy used that plays a part in deciding purchases and sales of electrical equipment.

Function and reliability, with quality, are important when purchasing white goods

When purchasing white goods, function and quality are two basic factors that influence the choice. An appliance must fulfil the household's comfort function requirements. Quality can be assured by purchasing a well-known brand: a brand that is recognised for its good quality inspires confidence in its choice. In addition, well-known brands and good quality go some way to meeting requirements for energy efficiency. It is only at this stage that factors such as energy efficiency come into the picture, followed by the need for the appliance to fit into the kitchen, both in terms of size and of visual appearance.

Children in energy advertisements signify enjoyment of life, a secure home environment and environmental consideration

A study* has shown that advertisements for electrical technology or equipment are aimed mainly at adults, but that children frequently appear in them.

Children are often used in advertisements for pools and other bathing items to indicate enjoyment of life. Bathing is a social activity, facilitating togetherness and pleasure, as well as luxury and a holiday spirit. Children are used as demonstrators of the intended applications of the item, while sales arguments are based on adults' willingness to provide children with opportunities for them to play and enjoy themselves.

When used in advertisements for appliances such as washing machines and cookers, children emphasise parental responsibilities: choosing and using equipment in order to look after their children in the best possible way.

There are also advertisements that explicitly exploit the concept of good care, by indicating the dangers and problems that can face children unless the particular products being advertised are used.

When, in rare cases, children are presented as subjects with their own wants and needs, and with a message to get over, this is normally in relation to environmental consideration. In these cases, the children are being seen as a symbol of the future, and as a group that naturally understands the need for care of the environment.

FURTHER READING:

Erika Jörgensen, Elforsk report no. 09:41

***Johanna Sjöberg, Elforsk report no. 09:65**

15 NEW OPPORTUNITIES WITH HOURLY METERING

The new requirements for monthly meter readings have meant that about 90 % of the meters that the network companies have now installed are also capable of providing hourly metering. This can bring benefits for consumers, and also opens up potentials for network owners and electricity suppliers to develop new business concepts. However, the present regulations and customer communications have not yet properly settled down.

Consumer benefits from hourly metering

- With better statistics, down to hourly levels, consumers can better understand their use of electricity, helping them to change their behaviour or habits in order to reduce their electricity use.
- With better awareness of their electricity use, consumers have better control over it, which has been confirmed by many surveys as something that customers want.
- New pricing structures, reflecting tariffs down to hourly bases, allow consumers to control their use of electricity to avoid, for example, price peaks.

Benefits of hourly metering for electricity suppliers, network companies and society

- Hourly metering makes it possible to develop new services to help consumers to budget, to analyse their electricity use and to control it.
- Provides the opportunity for offering tariffs down to hourly level, thus reducing electricity suppliers' risk exposure.
- Careful design of tariffs can help to reduce peak demand and make better use of network capacity.
- Collective measures to reduce load peaks results in overall improved utilisation of capacity, better security of supply, more efficient production and reduced price swings, for an overall result of generally lower price levels, thus benefiting all parties.

The potentials of hourly metering are still at a very early stage

If the best possible use is to be made of hourly metering, there will need to be changes in current regulations and additional infrastructure features for large-scale collection and reporting of the meters' hourly values. There is also a need for more concrete design and marketing of tariffs based on hourly values, which will have to be employed and understood by customers.

FURTHER READING:

Andrea Badano, Peter Fritz, Anders Göransson och Magnus Lindén, Elforsk report no. 07:62

16 CUSTOMERS ACCEPT DEMAND MANAGEMENT

Field trials of direct power management of heating in electrically-heated households show only a slight effect on comfort, but which customers find easy to accept. Tests of a prototype of a recently developed simple and cheap controller show that the technology of demand control exists and works. This provides a new way for energy companies to reduce aggregated peak loads.

A field trial has investigated the use of demand management of a number of electrically heated houses with waterborne electric heating systems, reducing power demand during times when the price of electricity was high. The results show that:

- The occupants were not inconvenienced by the power control: they hardly noticed the drop in indoor temperature when heating power was reduced during periods of high electricity price.
- The heating system did not try to compensate for the temperature drop after power reduction ceased, thus providing a lasting energy saving.
- It is possible to store heat delivered at times when the electricity price was low.
- The prototype of the cheap controller was found to operate satisfactorily.

Power management assists heat pump operation

Power management in combination with energy storage is particularly attractive for houses having heat pumps, as heat pumps are more efficient when the outdoor temperature is higher. During the winter, outdoor temperatures are usually highest in the afternoon, while the spot price of electricity is often highest just afterwards, between 17-19. A double gain can be achieved by increasing the drive power to the heat pump during the early afternoon, when it can operate at its best efficiency, and then reducing the power input immediately afterwards, when the price of electricity is at its highest.

Other opportunities for demand management

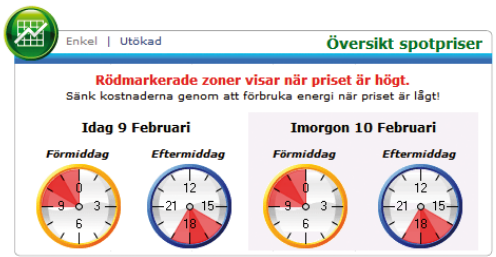
It should be possible to use the technology in the same way for buildings supplied with district heating. By controlling heat demand at particular times, the district heating supplier can optimise the production mix.

FURTHER READING:

Peter Fritz, Erika Jörgensen och Stefan Lindskoug, Elforsk report no. 09:70

17 CONTROL BY PRICE MANAGEMENT WORKS

Consumers react, and adjust their use of electricity, in response to the hourly price of electricity: this is shown by field trials of systems using hourly-based billing of electricity.



An example of a web portal page showing electricity prices

Field trials have been carried out involving hourly-based billing of electrically heated households. Households were given access to a web portal showing detailed information on their use of electricity and its costs, together with information on the relevant prices of electricity. The portal showed the price of electricity hour by hour during the current day and the next day. The project tested a tariff under which the customer was charged a variable price, but with a guaranteed fixed price for some of the usage.

Active response

The consumers in the trials were very active in controlling their use of electricity. They noted when the prices were high and low, and adjusted their use of electricity thereafter. The commonest response was to postpone the use of dishwashers and washing machines. However, the consumers were not prepared to go to absolutely any lengths to reduce their electricity during high price periods: for example, they still took showers even when the price of electricity was high.

Consumers learn how the price of electricity varies

The consumers were supplied with price data from the internet, which was regarded as a complicated route. More easily accessible display of current prices was requested. However, they quickly grasped a good idea of how the price of electricity varied during the day, and adjusted their use of electricity on the basis of expected prices, rather than on that of actual prices.

Despite not understanding the tariff, consumers responded correctly

The consumers in the trial asked a lot of questions in order to understand how the tariff worked. Nevertheless, a number of them did not understand that variable-priced tariffs could represent a cost risk for them: a more easily understood price model would have given better results. A price model that directly tracks the relevant market price is easy to understand.

FURTHER READING:

Peter Fritz, Erika Jörgensen och Stefan Lindskoug, Elforsk report no. 09:70

18 GOOD REASONS FOR NOT CHANGING ELECTRICITY SUPPLIER

Although the Swedish electricity market has been deregulated for more than ten years, and consumers have been able to choose their electricity supplier and tariff, statistics show that the actual number of changes is low, but do not indicate the reason for this. An ELAN study has shown that it is not laziness behind consumers' disinclination to change tariffs or suppliers: instead, there are several good reasons for them apparently not actively entering the electricity market.

Many consider changing, but few do so
The group of consumers who do not change their supplier or tariff are often regarded simply as passive. The ELAN study shows that they have, in fact, often considered doing so, but have decided not to. The reason for this can be that the consumer is satisfied, and loyal to his supplier; that the consumer has decided that any benefit from a change would be insignificant; or that he is afraid that something would go wrong, causing more trouble than benefit. A few consumers state that they have not felt like getting involved – the reason being not that they lack information on making changes, but have not had time, or been able to spare the effort, to deal with it.

Information available: clear, but not inspiring
Consumers are well aware that they can change their supplier. Suppliers' information on electricity and tariffs is seen as important, correct and believable, but does not actually inspire consumers to take action. If consumers are to change their contract tariffs, they need more specific information, setting out reasons to support changes.

Links to the customer
Consumers may have various links to their electricity supplier, with the character and number of these links being important in determining how they act. The electricity suppliers try and create several different types of links to their customers. Consumers feel more closely tied to a combination supplier,

i.e. a single company supplying electricity, heat, network services etc. This mitigates against changing supplier. Consumers living in electrically heated houses (one link) are more active on the electricity market and actively seek information. Such households also tend to have high levels of energy use.

Change of supplier makes little difference, and can cause problems
One group of consumers feels that there is no point in changing supplier, as the differences between suppliers or their tariffs are small. Although there may be differences on some particular occasion, they can all too easily disappear a little later. Other consumers reckon that changing suppliers is difficult, and can result in problems such as double billing.

FURTHER READING:
Åsa Thelander, Elforsk report no. 09:08

19 WATER AND HEAT ARE THE GREATEST WORRIES IN THE EVENT OF A POWER FAILURE

Electricity consumers in sparsely populated areas are generally both mentally and literally prepared to deal with longer power failures. They rely on distributors quickly to deal with faults, with most of them saying that they can accept power failures of 12-24 hours' duration before problems begin to arise and they start to phone to ask how long the failure is expected to last. Many households have access to portable electricity generators or wood-burning stoves. Most of them also have candles and torches at home. Other consumers seemed to regard power failures as a part of normal daily life, and had no particular preparations for dealing with the various consequences of a power failure.

It was problems with water supply that consumers regarded as the most troublesome effect of a power failure. At the same time, they also found that this particular problem was often resolved by the local authority making sure that water was available at strategic places. Consumers stated that they felt that the greatest problems arising from a power failure were:

- Water
- Sanitation
- Keeping the house warm
- Freezers
- Lack of artificial light
- Information – or rather, lack of it

Cooperation delivers better planning and clearer information

Municipalities having good links with electricity distributors were better at determining priorities and providing clearer information in the event of power failures. Good cooperation also means that municipalities can plan in good time, and prepare their responses before a power failure occurs. However, cooperation between municipalities and power distributors can vary widely: in some cases, there may be informal networks, while in many other cases there are no particular links.

FURTHER READING:
Jenny Palm, Elforsk report no. 08:15

20 SMALL-SCALE ELECTRICITY PRODUCERS WANT TO CONTRIBUTE, PROTEST AND BE SEEN

Domestic solar panels and wind power plants have started to establish themselves on the market. Householders producing electricity have mainly chosen to do so for idealistic reasons. However, small electricity producers will also need to be able to sell surplus electricity, but there is still confusion about the rules.

Environmental consideration

Home-owners choose to invest in solar cells or wind turbines for predominantly environmental reasons. In some cases, the households are strongly green: investing in this technology is a way of doing something practical in respect of energy. For others, investment may be symbolic, to provide an outward indication that the household is environmentally aware, and to give a good example. For a few more, investment is a protest against 'the system', with its large overwhelming players, or a way of becoming more self-sufficient. Small-scale electricity producers are generally relatively well educated, and have good incomes.

New opportunities for energy companies

This is another area that can provide a new business opportunity. Small-scale electricity production is a new and interesting market. By purchasing electricity from solar panels and micro-turbines, the energy companies provide added value to their customers while at the same time being able also to provide added value to other customers through the sale of green electricity. The network companies are in favour of households producing their own electricity, although there are at present certain problems that must be solved.

Hourly metering and smart grids need to be developed

Simpler administrative procedures and more flexible legal requirements in respect of such aspects as hourly metering of small-scale plants are needed, and can be expected. However, it is not clear how the network companies will deal with widespread installation of small-scale plants, nor of what network reinforcements that may be needed. This is an area where further development is required.

FURTHER READING:

Jenny Palm och Maria Tengvard, Elforsk report no. 09:64

REPORTS

Note: The following reports, of which the titles have been translated, are all in Swedish, but have English summaries.

Elforsk 07:44, *Graphic presentation of consumption – an overview.* Tim Hallin, Inger Lindstedt, Tove Svensson, K3, Malmö University

Elforsk 07:61, *Heating in homes. A quantitative analys of energy use.* Anna-Lisa Lindén, Lund University

Elforsk 07:62, *Hourly metering for all. Benefits, regulations and costs.* Andrea Badano, Peter Fritz, Anders Göransson, Magnus Lindén, EME Analys and Profu

Elforsk 08:15, *Crisis management in the electricity system – Electricity distributors', local authorities' and consumers' views of their roles and responsibilities in power failures.* Jenny Palm, Linköping University

Elforsk 08:18, *Visualisation of electricity use in apartment buildings.* Cajsa Bartusch, University College of Mälardalen

Elforsk 08:23, *Domestic consumption across the generations – Purchasing habits for electrically powered domestic equipment and energy.* Annika Carlsson-Kanyama and Ann-Sofie Stenérus, FOI Swedish Defence Research Agency

Elforsk 08:25, *Visual Watch – Electricity status on your mobile.* Magnus Bång and Frida Birkelöf, Interactive Institute

Elforsk 08:54, *Modelling of domestic electricity load curves from usage time data.* Joakim Widén, Uppsala University

Elforsk 08:75, *New meters are coming – A study of information concerning the introduction of individual electricity meters.* Karin Mårdsjö Blume and Inger Lindstedt, K3, Malmö University

Elforsk 08:76, *The new meter arrived – what happened? An interview investigation of customers' expectations of the new electricity meters.* Inger Lindstedt and Karin Mårdsjö Blume, K3, Malmö University

Elforsk 09:08, *Households on the electricity market – Information and action.* Åsa Thelander, Lund University

Elforsk 09:38, *Visualisation of electricity use in apartment buildings.* Cajsa Bartusch, University College of Mälardalen

Elforsk 09:41, *Heating homes – Influence factors and decisions.* Erika Jörgensen, Lund University

Elforsk 09:57, *Electricity – what is it? – A concept for communication on electricity.* Christel Brost and Inger Lindstedt, K3, Malmö University

Elforsk 09:58, *Communication on energy and everyday questions.* Inger Lindstedt, Karin Mårdsjö Blume and Christel Brost, K3, Malmö University

Elforsk 09:64, *Small-scale electricity production for sustainable development – Householders', energy utilities' and distributors' experience of the market for electricity from small-scale solar panels and wind turbines.* Jenny Palm, Maria Tengvard, Linköping University

Elforsk 09:65, *Some thoughts on children and energy technology in advertising and information materials.* Johanna Sjöberg, Linköping University

Elforsk 09:70, *Following electricity prices more closely – Field trials of price models and control technologies.* Peter Fritz, Erika Jörgensen and Stefan Lindskoug, EME Analys and Lund University

Elforsk 09:86, *Energy thief or a means of saving? – On the use of information and communication technology in the domestic environment.* Kristina Karlsson and Eva K. Törnqvist, Linköping University

Elforsk 09:90, *Electricity information via digital channels – a potential to modify electricity use in the home, synthesis.* Jurek Pyrko, Lund University.

Elforsk 09:98, *Sustainable learning about indoor heating? Domesticating energy technology in passive houses.* Charlotta Isaksson, Linköping University


ELFORSK
Energimyndigheten
Jämtkraft
Drivkraft för regionen
SKELLEFTEÅ
kraft
ÖRESUNDS
KRAFT
Borlänge Energi
e·on
VARBERG ENERGI
Göteborg Energi
Alvesta Energi
100% smålänning
UMEÅ ENERGI
Fortum
VATTENFALL

This report presents a collation of results from the ELAN project; a research programme into how the habits and values of users affect their use of electricity. The report presents operationally useful results for all those who, in various ways, are involved in the provision or use of energy. The purpose of the report is to provide an easily comprehended and thought-provoking overview of the results from the programme.

ELAN
PROGRAMMET