

Reference Study

Green Citizens Life+ – Action B2

AB Bostaden | Umeå, Mia Han • Umeå 31-12-2011



Action B1: Energy Efficiency, Sustainable living and housing – **Echolog**

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Life+ the Green Citizens Project – Reference report 31-12-2011

Action A1: Workshop I – Turku 31-01-2011—02-02-2011
Workshop II – Umeå 17-09-2013—19-09-2013

Action B1: Energy Efficiency – Sustainable Living and Housing

Action B2: Reference Study

The Appendices **Timescale** and **Reference Survey** are available on request.

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Introduction

Bostaden, together with the electronics firm Abelko, is developing a display known as Echolog for the individual measuring of electricity and water consumption (Action B1). In 2015, during the course of the project, it will be mounted in a clearly visible position in the hall of a total of 500 apartments. The display is being tested with four different interfaces as part of this reference study (Action A2), the aim being to find out how to design as user friendly an interface as possible. At the time of writing (December 2011), the Echolog has already been installed in 260 apartments.

The purpose of the Echolog display is to enable the tenants themselves to control in real time the energy consumption of their household electricity and hot and cold water. At the same time, tenants will be provided with statistics regarding past consumption, and will in that way be able to influence their costs.

At the conference in Åbo between 31 January and 2 February 2011 (Action A1), we introduced the prototype and also participated in a workshop which met with a huge response and a positive reception.

We have had internal as well as external meetings with collaborative bodies such as the Institute of Design and Umeå University. Meetings have also been held on a continuous basis with our Green Citizens partners in order to update developments regarding the subprojects.

The Reference Report

The reference report provides comparisons of lessons learnt during the early part of the project, and states what we have done up to now, what we will be doing in the near future, and what are the project's goals.

Background

Several years ago, the transition was made from collective to individual measuring of household electricity. This meant the tenants being debited for their actual consumption instead of the cost being distributed collectively and built into the rental charge. Consumption of household electricity was then substantially reduced. This gave rise to the idea of further promoting awareness among tenants of their private consumption by means of visual measuring in real time. At the same time, Bostaden wished to add the feature of measuring consumption. This needed to take the form of a visual display that would be attractive and dynamic in order to be able to maintain interest over time. Initially, the consumer may save energy in order to reduce charges. However, we believe that this could in the long run lead to an automatic change in behavior in favour of a greater environmental awareness on the part of the user.

As early as during the planning stages of the work done on the Solvik residential area in Öbacka, we at Bostaden have wondered how we can get tenants to consume less energy. Together with the technology company Abelko, a prototype was produced, and the Echolog became a reality. Since then, Bostaden's IT unit has worked on developing the interface and functions in the terminal.

What we wanted, right from the time the idea of an individual control device was raised, was a display in real time that would enable the tenant to see immediately whether there was any deviation in consumption and to take direct action. We also wanted to work on producing an attractive and simple display in order to maintain interest and make it as clear to the user as possible. This terminal is primarily a device for not only saving energy costs but also saving the environment in the long term. Since the tenant is charged for his/her own consumption, and has influence over that with the aid of Echolog, a reduction in Bostaden's costs is not the main priority.

Sustainable Ålidhem

We developed a terminal with a flexible design on a platform with an open solution in order to have the opportunity in the future to add supplementary features to the Echolog in the form of services and functions. At the same time, the project Sustainable Ålidhem was started with the support of the Delegation for Sustainable Cities, a state organization. As part of this project, Bostaden, together with Umeå Energi and Umeå municipality, will develop Ålidhem into a more sustainable city area with a safer and more pleasant environment and half the energy consumption.

At the start of the EU Life+ project, the Echolog terminal had already come into being, but we wanted the opportunity to carry out an in-depth investigation in order to evaluate how to produce a device with a long life for our tenants and thereby for the environment. This is the reason why the Echolog came under subproject B1, known as Sustainable Living and Housing.

The Current Situation

At the time of writing (December 2011), the Echolog terminal, now installed in 260 of Bostaden's apartments, has been distributed as shown in the table on the next page.

Area	Apartments	Average size	Active Echologs	Year built
	No	m ²	July 2011	
Solvik 1	165	62.29	165	2010
Matematikgränd 9	10	66.46	10	1971*
Kärven 10 (101)	17	52.07	11	2011
Kärven 10 (102)	29	66.85	29	2011
Hunden	46***	57.5	45**	2011
	***Ready in autumn 2011		** Not part of ref. study	*Improved 2011

All newly built apartments completed in 2010 and thereafter have been equipped with the Echolog, as has a renovated housing unit on Matematikgränd. The experiences of the tenants living here have formed the basis for this reference study. A selected number of these tenants will also be participating in the in-depth evaluation study to be carried out during 2012-2015.

The apartments in the new residential area of Hunden became occupied in the autumn of 2011 and do not therefore form part of the survey or reference study. The reason for this is that these tenants have not had long enough time to use the Echolog in order for a fair evaluation to be made.



The Reference Survey

In order for Bostaden to have a platform on which to develop the Echolog further, a reference survey was carried out during the autumn of 2011.

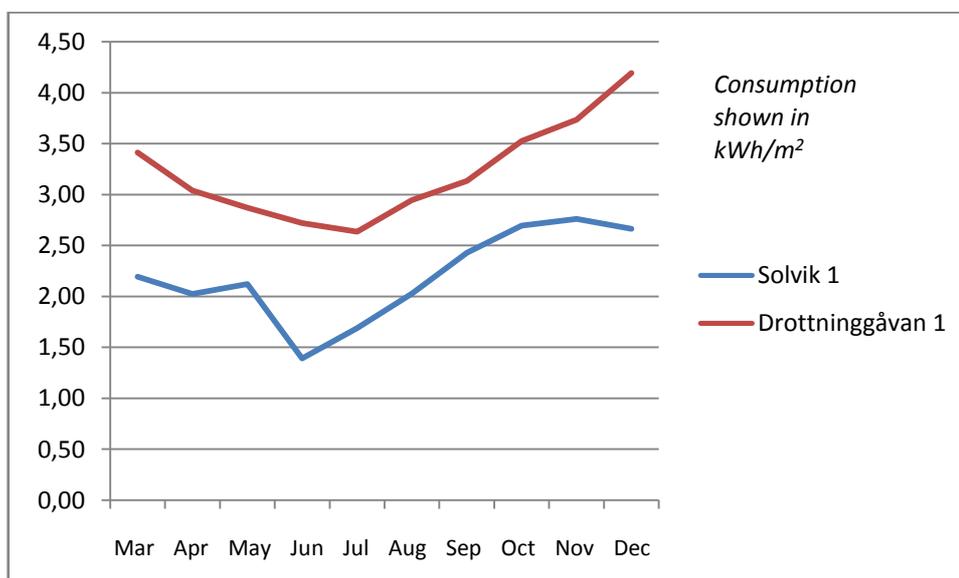
The survey was divided into three sections: Facts concerning Tenant and Apartment, Environmental Awareness and Behavior, and also Public Opinion regarding the Echolog. Moreover, we gave the tenants the opportunity there and then to express their interest in participating in the evaluation group.

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All households whose apartments were equipped with the Echolog at the time of the survey being sent out received their copy by post, with the exception of the Hunden residential area on Öbacka which, as has already been mentioned, was not covered by the survey's area of distribution because it had only recently become occupied. One week later, we sent out a reminder, and a week after that was the closing date for submitting a response. We gave the tenants the opportunity either to return their response to the survey in the enclosed envelope or to submit their completed form to their area landlord. We received 86 responses out of the 215 forms sent out.



Household Electricity

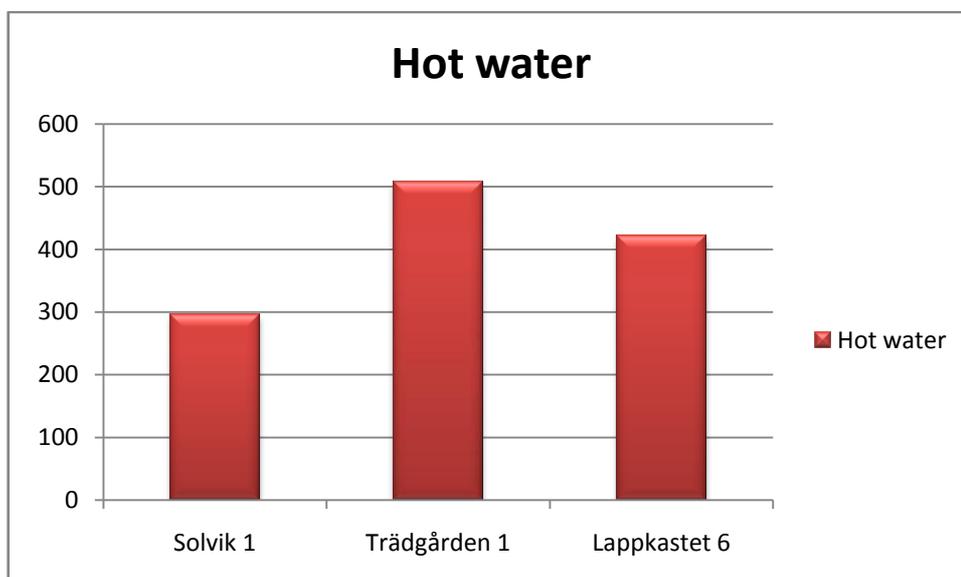


Analysis of household electricity

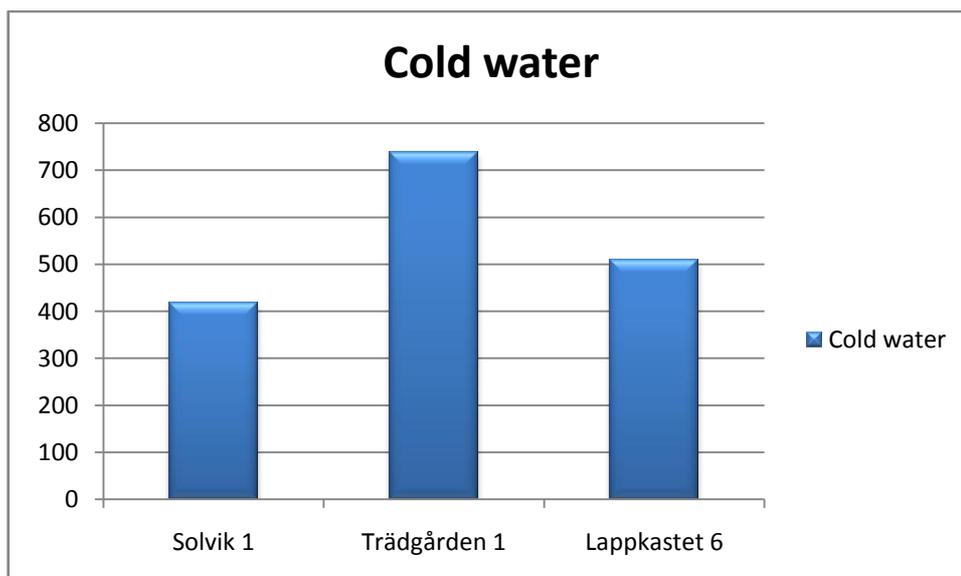
In comparison with the reference area, the Echolog area shows a considerable reduction in electricity consumption. The difference is sufficiently great to take into account the impact made by the Echolog, one which is relatively constant during the year. It is particularly interesting to note that consumption behavior follows the normal cycles, with higher consumption in wintertime and lower in summer. However, the Echolog users show a lower level of average consumption.

It is possible to discern the clear impact made by the Echolog on the residents' electricity consumption during the period of measurement. Future evaluation will show in turn whether consumption can be maintained at this lower level over a longer period of time.

Water Consumption



Liter per square metre and year



Liter per square metre and year

Analysis of water consumption

The results of the comparison regarding water consumption do not provide a completely clear picture. Since water, in contrast to electricity, is not measured per individual household in any housing units other than those equipped with the Echolog, the measurement values are uncertain. The measurement data received from Trädgården 1 and Lappkastet 6 are based on collective consumption. It is difficult to break down this data in terms of individual households in these housing units, therefore the results are compared with the total living area for each housing unit and are expressed in terms of square metre and year.

The measurement data show that Solvik 1 has a lower level of consumption than both Trädgården 1 and Lappkastet 6, and also that there is a big difference in consumption between Trädgården 1 and Lappkastet 6. It is hard to point to any single factor responsible for the discrepancy between these areas, but it clearly shows the difficulty in making comparisons regarding water consumption.

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The lower level of consumption in Solvik 1 indicates, however, that the Echolog has an impact on consumption, and the reduction lies within the boundaries of what can be expected, based on other studies carried out as part of other projects such as SESAC in Växjö. Evidence of the impact made by the Echolog on water consumption is also provided in the survey carried out among tenants using the Echolog, where the responses show an increased awareness of water consumption.

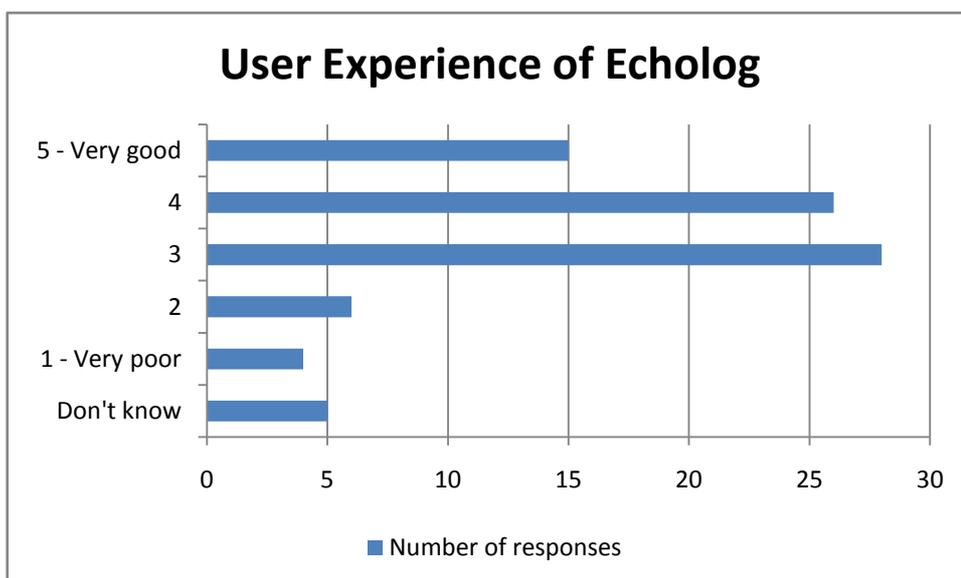
Future evaluations will show whether the reduction in consumption measured will be sustained over time. There is also a need to refine the method of comparing the water consumption of different areas in order to achieve greater accuracy in the measurement data.

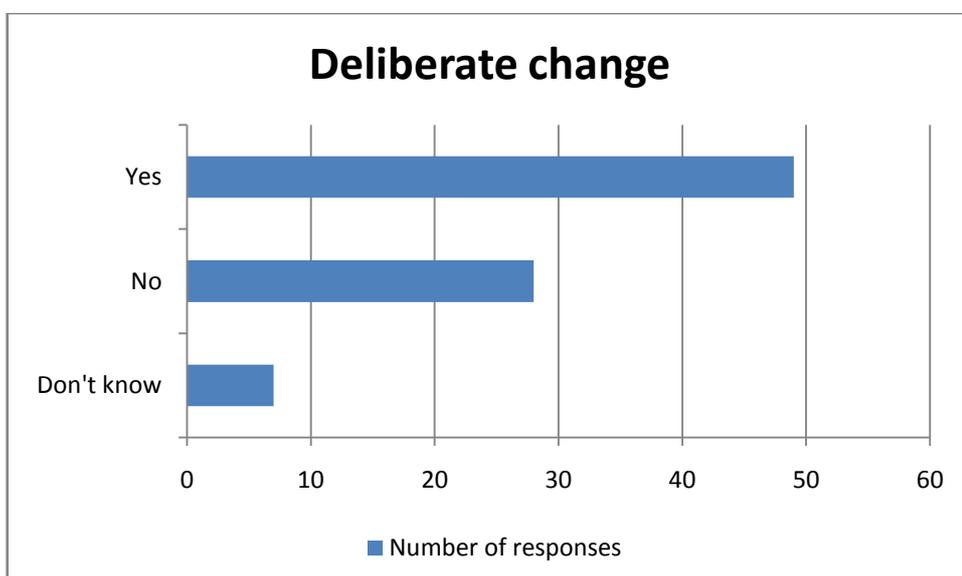
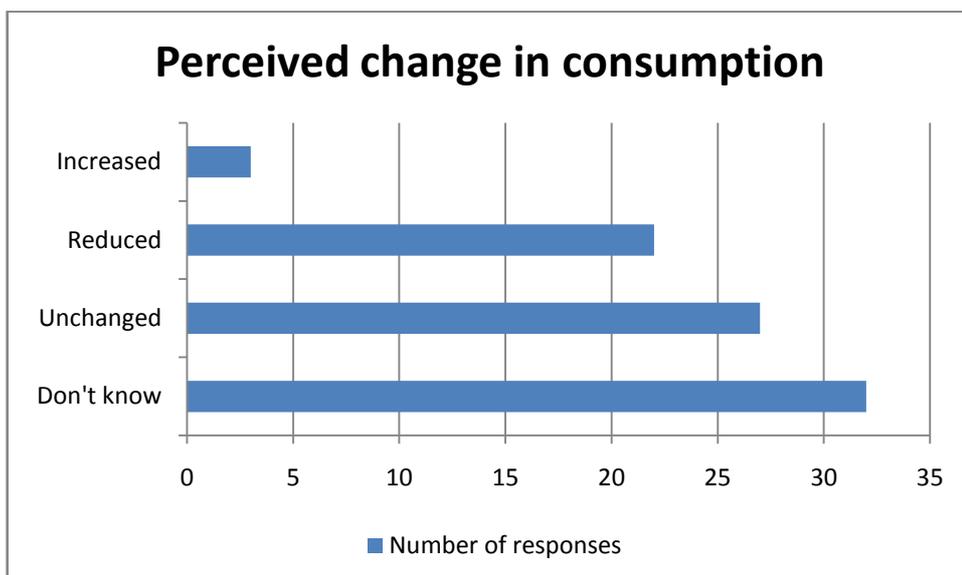
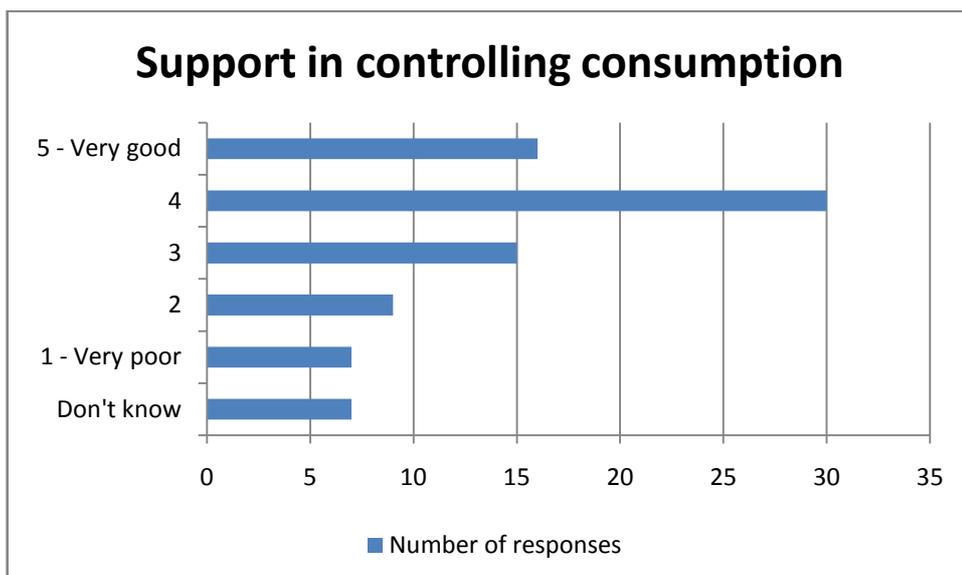
Results of the Reference Survey

The outcome of the survey shows a generally positive attitude to environmental thinking. Many of the tenants regard themselves as being environmentally aware, and they take environmental implications into consideration when buying groceries, sorting waste and using transport. It is, however, difficult to determine on the basis of the responses to the survey whether this is a factor clearly influencing electricity and water consumption.

Echolog – User Experience and Support

An important part of the investigation has been to evaluate whether tenants feel the Echolog has been of support to them in controlling their consumption, and whether they feel it has helped them in its reduction. A summary of the relevant responses to the survey is shown below:





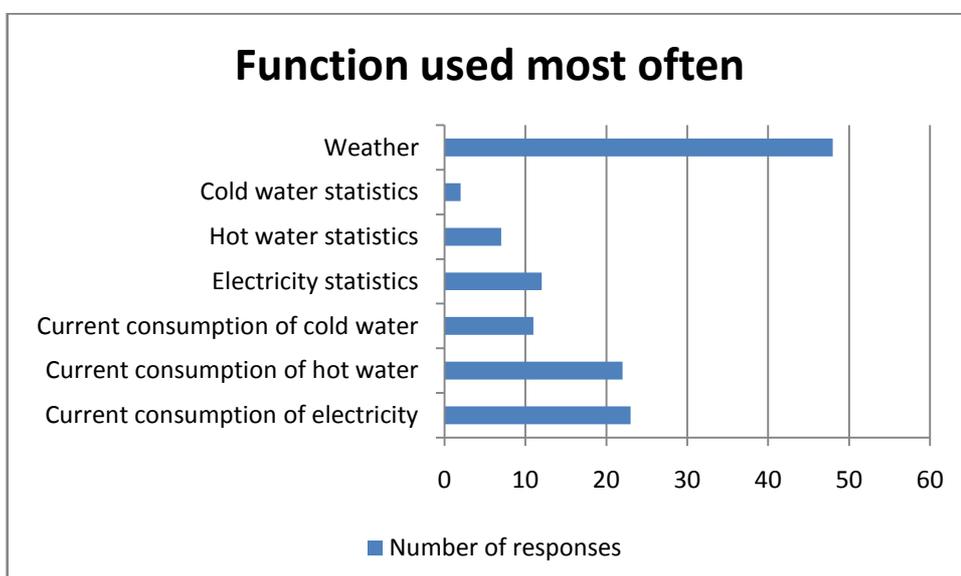
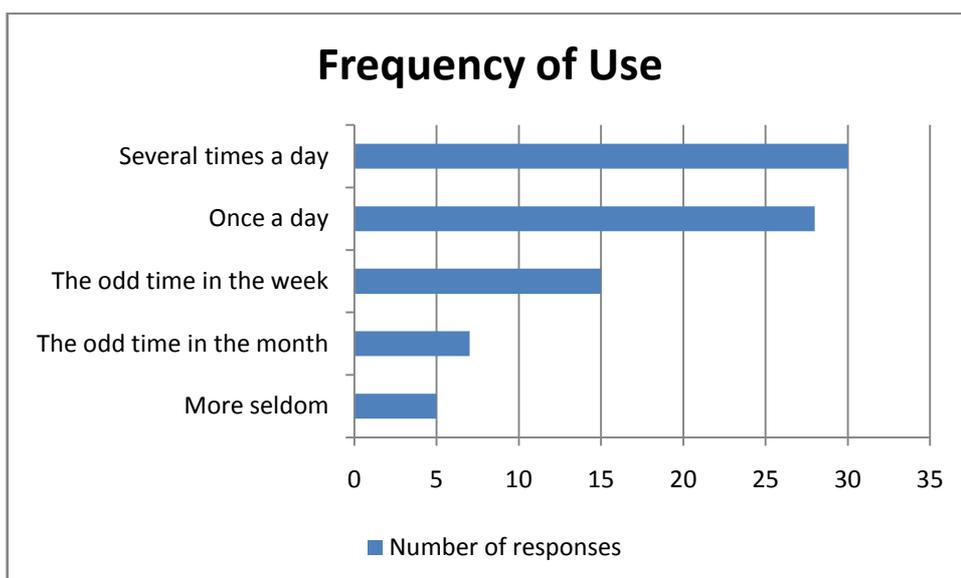
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The results show that the Echolog does on the whole meet expectations in serving as a resource and tool for tenants in reducing their consumption. The responses are shown to be mainly positive, as regards both the Echolog in its entirety and the question of whether it facilitates the control of one's own consumption.

The tenants express some uncertainty as regards their experiences of the change in consumption, at the same time as many say they have taken deliberate measures to reduce their consumption. We judge this result to be a natural consequence of the difficulty experienced by the tenants in actually comparing past with present consumption. However, the consumption statistics show that tenants who have the Echolog reduced their average consumption when compared with those who do not. This is something we need to focus on in the future: to communicate the tenants' results in a clear way, with the aim of increasing motivation to maintain environmentally aware behavior.

Echolog – User Patterns

The survey also provides answers regarding the way in which the Echolog is used, how often tenants look at the display, and which functions they prefer.



The results show a generally good frequency of use, where the majority of tenants state that they check the Echolog at least once a day or more. This is in line with expectations: if the Echolog is to have a supportive function in reducing consumption, it must be used frequently.

As regards which function was most appreciated, the responses show a clear preference for the weather display. A significant proportion of the respondents state that this additional function is the one used most often. These results meet expectations: the weather display was included with the aim of attracting interest in the Echolog, and it seems to have had the desired effect.

Criticism

Although the results show a generally positive trend, there are also a number of tenants who are not satisfied with the Echolog and who do not use it to as great an extent as do the others. This is seen primarily in the comments provided in the survey, where respondents had the opportunity to express their opinions regarding the good and bad aspects of the Echolog, what could be improved, and what would encourage its increased use. The comments were many and often constructive as regards both the good and the bad. This can be seen as a sign that the Echolog also attracts the attention of tenants not totally satisfied with its function and appearance.

The responses provide a number of clues about what is important for the future development of the Echolog. Confidence in the information provided is, as expected, absolutely essential. A number of teething problems have come to light which has meant reduced confidence on the part of some of those tenants affected. Also, some tenants have not found the function for setting the individual electricity price, which has resulted in electricity bills not corresponding to that displayed on the Echolog.

There have been a number of comments regarding the way in which the information is displayed and the fact that it can be patently obvious at times of high consumption. This agrees with several of the early interviews carried out with tenants in the spring of 2011, when some tenants regarded the interface as being condemnatory. Getting the balance right between the patently obvious and being given too little information is difficult yet at the same time essential. This is a matter needing attention as the device is further developed.

The level of brightness in the display is an aspect attracting much attention: some users like it while others do not. Problems will arise if this starts to be seen as irritating and this would drastically affect the overall impression of and confidence in the Echolog. This too is an important area of focus for future development.

Summary

- Positive image
- Marked reduction in consumption
- Of interest to many tenants
- Valuable comments

To summarize, this comparative study of the Echolog and its reception by user

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tenants – a more far-reaching study and the first of its kind – provides a positive picture. The results regarding consumption show a marked reduction, and everything points to the role of the Echolog and its influence on consumption to be in the manner expected.

The reception given to the Echolog on the part of the tenants has been good on the whole, and it seems to have attracted the interest of many. This interest is also shown by a number of the less satisfied tenants, who provide many valuable comments.

The challenge will be to carry on the progress made and to incorporate the constructive criticism in developing the system further. The goal is to maintain a lower average level of consumption in the housing units equipped with the Echolog than that in those not equipped with it. At the present time, we know that the Echolog has a short term effect on consumption. Future evaluation will show whether this effect will be a long lasting one.

The Future

Our intention was for both newly built and renovated buildings to be installed with the Echolog, but conditions in the renovated buildings mean that installing it at the present time is not financially tenable. Its installation would involve having to replace all or parts of the plumbing system at great additional cost which would be unwarranted. We will in the future, therefore, only equip newly built apartments with the terminal – at least 500 apartments in total during the course of this project. If, however, during the course of further developing the Echolog we find another, more financially tenable solution as to how to install it in renovated housing units, we will review our decision not to install it in older buildings.

Our goal is for all apartments in the future to be equipped with the Echolog terminal in order to increase awareness and thereby encourage our tenants to reduce their energy consumption.

Bostaden's Environmental Program

The aim of Bostaden's environmental program known as "Environment Focus" is for energy consumption in the company to be reduced by 20 per cent in total between 2008 and 2016. The introduction of individual measuring for tenants and a visual display for energy consumption should help achieve that aim.

The basic idea behind the project is the desire for our operations to be based on ecocycle thinking which reduces the burden placed on the environment we all share. Success requires an increased environmental awareness on the part of tenants, employees, suppliers and entrepreneurs. The work of Environment Focus is divided into five areas: Energy Consumption, Waste Management, Building and Materials, Transport, and Awareness and Commitment. Each area is headed by a subproject manager who, together with his project group, has the task of realizing established goals.

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The Echolog

The Echolog terminal is a 5.7" LCD touch screen which shows the household's consumption of household electricity, hot and cold water and also graphic data. All consumption is shown in real time. As well as consumption, the Echolog shows current weather conditions as well as a weather forecast for the coming days. On the undersides of the Echolog there are statistics showing current as well as past consumption, making it easy for the user to draw comparisons.

All households equipped with the Echolog terminal pay for their household electricity and hot and cold water themselves. The alternative, which is common in Sweden, is that the tenant pays only for his household electricity and that other consumption costs are included in the rental charge.

The Echolog terminal also has a message function whereby the area landlord, for example, can inform his/her tenants of possible disruption, such as cutting off the water supply or similar. At the present time this function is used only as a channel of information, not as a two-way communication.

Four New User Interfaces

The four new user interfaces to be evaluated have different designs.



One of the interfaces has a main menu with "analog" meters showing consumption. The idea behind this "analog" representation is that the user recognizes this type of meter and finds it easier to understand. Current weather conditions are shown on the start page.

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Another interface has symbolic graphics, whereby electricity consumption, for example, is shown in the form of a battery and hot water in the form of a teapot. This interface does not have a display in real time. The day's consumption is updated at a slower pace in order not to seem condemnatory when consumption is high at that time. The weather is shown on the start page too.



We will also allow the tenants in the evaluation group to try an interface where consumption is represented in more abstract form by way of bars indicating levels of consumption and which stream out from the middle of the main view. This interface, in stark contrast to the other interfaces, does not show the weather forecast on the start page.

The fourth interface shows electricity consumption in real time, while water consumption is shown on a cumulative basis per month. This interface shows clearly both weather and the date and time on the start page. At present, development on this interface has just begun, so we have no image on display here.

Method used for the forthcoming Evaluation Study

Bostaden has collected data showing energy consumption patterns in the rental apartments over a long period. Data is available from both the housing units with the Echolog terminal and those without. This is because we want to be able to monitor whether energy consumption has gone down after installing the Echolog, and also to see how different designs for the user interface affect tenant behavior.

In order to be able to develop the Echolog, an evaluation group of tenants for more in-depth evaluation will be set up. We have opted to allow this same group to test all four interfaces so that we can achieve as fair an evaluation as possible. It will also be easier to evaluate the results if the same individuals have been able to use all the different interfaces. Each time a new interface has been put on their Echolog, the members of the evaluation group will have the opportunity to give their immediate reaction to it in the form of responses to a survey. After 4-5 months we will carry out in-depth interviews, when we will ask the test participants what they think of each interface after having got used to them. Since there are four different ones for testing, these in-depth interviews will be carried out four times - one interview per interface.

This method has been chosen because it is not possible to provide the same conditions in the groups. It is therefore more rewarding to have all the test participants test all the interfaces to provide a more personal comparison, instead of having different individuals test different interfaces.

Reference Apartments

Comparisons of household electricity and hot and cold water are made separately. In order for the comparisons made to be as fair as possible, those reference apartments who do not have Echolog are as similar as possible in terms of size and demography to those which do. In Sweden usually tenants pay themselves for household electricity, which means that apartments for comparison are relatively easy to find. Hot and cold water, in contrast, are harder to compare, since the cost of water in common parts of the housing unit is spread across the apartments in each housing unit.

Drottninggåva 1 (181 apartments), Trädgården 1 (79 apartments) and Lappkastet 6 (506 apartments) are our reference housing units. These buildings do not have an Echolog terminal in their apartments. We have chosen these in order to see over time how the tenants' energy consumption is reduced in apartments which have Echolog in comparison with apartments which do not.

Household Electricity

Drottninggåva 1 was selected as a reference housing unit for Solvik 1. The households in these areas consist of apartments of varying sizes, although few of them accommodate children.

Area	Apartments	Average size	Year built
	No	m ²	
Drottninggåva 1	181	74.27	1987,1988

Hot and Cold Water

Finding apartments for the comparison of hot and cold water consumption was more problematic than it was for household electricity because collective metering also covers common areas in the housing units. What is more, the Solvik1 area has mostly young and elderly tenants and not so many families with children. This means it was difficult to find areas for comparison. In addition, common areas and premises had to correspond to those in Solvik 1 because the cost of water for all common areas is divided to form part of the rental charge for each apartment in the housing unit.

Given the factors mentioned above, Lappkastet 6 and Trädgården 1 were selected as the areas of comparison. Lappkastet 6 is a larger area, but the average size of its apartments is somewhat smaller than those in Solvik 1. Trädgården 1 has fewer apartments than Solvik 1 but the average size of these apartments is somewhat larger. Both these areas taken together are thus fairly representative of Solvik 1.

Area	Apartments	Average size	Year built
	No	m ²	
Trädgården 1	79	70.26	2000
Lappkastet 6	506	42.86	1964*,2004, 2005
			* Improved 1989

Limitations

The limitations of the Echolog terminal may in some cases be to do with the screen, depending on which functions one wishes to add. The fact that the terminal is a fixed installation in the flat can also be seen as a limitation. However, the intention is that it should not be possible to remove the terminal; rather, it should be something which is permanently in place and which the tenant can look at when passing in order to notice any deviations in consumption. The wall mounting also indicates that the Echolog belongs to the housing unit and is not something the tenant takes with him or her on moving out. The weather forecast is rather like an extra function thrown in, one which the vast majority of our tenants are very interested in having.

A further limitation at present may be that the terminal is not adapted for use by the disabled, such as those with visual impairment. However, we see no obstacle in future to being able to produce a version of the Echolog whereby the user can tailor the interface to suit him or herself.

In the current version of the user interface in the Echolog, there is only a one-way communication whereby the area landlord, for example, can inform tenants about possible disruption. However, there exists every opportunity for introducing a two-way communication in the open platform, even though this is not an issue at the present time.

Forthcoming Evaluation Study

For the purposes of the evaluation study, a group of households will be selected from as broad a user perspective as possible among those households who have the Echolog. The evaluation group will test all four of the new user interfaces over a period of four to five months each. In-depth interviews will be conducted at the end of the test period of each interface. These in-depth interviews will then be compiled, after which we will evaluate which functions, colours, services and so on might prove the most appealing to the user. We will draw on the lessons learnt when we finally decide on which user interface the Echolog is to have. After that, we will develop this interface further and introduce it in all the Echolog terminals in Bostaden's housing units.

Bostaden will hold a number of briefings with the group of tenants selected. Different activities aimed at sustaining a high level of motivation among the selected group members will also be held, such as an outdoor party for all Echolog users and a quiz about the Echolog which would be a good opportunity to spread information and facilitate dialogue regarding individual measuring. During the spring we will also be putting up digital notice boards on which to provide information about the project. This will take place in the areas whose apartments are equipped with the Echolog terminal: Solvik 1, Kärven 10 and Matematikgränd 9, Hundén and also Bostaden's newest area on Geografgränd.

Timescale

The evaluation study will be carried out in the period from 2012 to the last quarter of 2014, in order to produce a final evaluation and report in March 2015.

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Conclusion

The task of selecting those to be part of the evaluation group will begin in early January 2012, and we will also look at the feasibility of having several test participants write an Echolog diary for publication on the project's and Bostaden's websites. Our external consultant is currently working on the programming of the new interfaces. The first two interfaces will be completed by the turn of the year 2011/2012, while the other two will be delivered at the end of January 2012. Thereafter, these interfaces will be used by the members of the evaluation group during the test period 2012-2014. Continually updated information will be provided on Bostaden's website www.bostaden.umea.se and on the Green Citizens website www.greencit.se.

Umeå, 31 December 2011