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D7.2 eSESH Pilot Outcomes

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Revision History and Statement of Originality

Revision History

Revision	Date	Author	Organisation	Description
0.1	Oct 2012	Ulrike Hacke, Günter Lohmann	IWU	Providing framework of D7.2
0.2	Oct 2012 – Jan 2013	Günter Lohmann	IWU	Providing tenant survey data sets in SPSS
0.3	Dec 2012 – March 2013	Pauline Gravoille	HTC	Data cleansing and consumption data analysis
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0.8	March-April 2013	all pilot sites and Werner Korte	(see above) empirica	Final review and edit

Statement of originality

This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

Contents

1 Introduction

The eSESH project aimed at a significant reduction of energy consumption and CO_2 emissions. As described in the Description of Work (DoW) the present deliverable reports on the pilot outcomes and provides an impact analysis of the eSESH services – energy awareness service (EAS) and – where applicable – energy management service (EMS) in terms of actually measured energy savings.

Corresponding to the objective 4.1 of the ICT PSP Work Programme 2009 (ICT for energy efficiency in social housing) EAS and EMS base on advanced ICT components in the context of smart metering, local generation of power and the management of renewable energy and are addressed to the requirements of social housing tenants who often live in situations characterised by low incomes, low education levels and low home-based internet access rates.

ICT-based consumption feedback strategies which are overall used in the eSESH project in the form of tenant web portals, smart phone applications, TV solutions or in-home-displays shall enable users to get a better knowledge about their energy consumption at home. Smart metering technologies allow well-illustrated feedback of consumption-periods of less than a year with historical (previous periods), comparative and normative comparisons (average consumption of the building, the neighbourhood, similar households, etc.). In addition to that the EAS provides further information on energy consumption issues, energy saving tips and tools which allow a self-assessment of someone's current energy consumption behaviour or a personal benchmarking and alert system. Based on that tenants can learn to act in a more energy conscious way.

From some pilot sites furthermore developed EMS contain different functionalities. Related to heat energy consumption the EMS usually allows to monitor the heating system, to optimise the modus of operation and to solve malfunctions. Further areas of application are the maintenance of a centralised solar system for domestic hot water (DHW) or the realisation of load shedding possibilities in case of electricity aiming at peak-demand reduction.

When understanding the climate protection as a task of the society as a whole it becomes quickly obvious that single strategies or instruments cannot be sufficient to achieve the energy efficiency targets. That's why the ten social housing providers in the eSESH context initiated energy awareness campaigns addressed to all pilot tenants. Even if parts of the pilot tenants didn't make use of the web-based EAS caused by the comparably lower rate of internet access or caused by low internet affinity, they had the opportunity to attend information meetings or tenant trainings, to get support from energy coaches and/or to receive further information material in terms of brochures, letters with consumption feedback similar to the web portal information and so on.

That's why the calculation of savings is first of all related to the whole pilot sample which covers in total more than 3,700 tenant households.

As the following evaluation results show, the eSESH service – embedded in holistic energy awareness campaigns of social housing providers – is an appropriate instrument to empower social housing tenants to increase energy efficiency at a high level.

2 Evaluation approach in eSESH

The evaluation methodology has been described in detail in the deliverable D7.1 'Evaluation plans for eSESH'. In the following the main aspects will be revisited in order to give background information and to allow a better understanding of the savings calculation and impact analysis for readers. In addition to that, the following section will provide explanations regarding particular deviations from the original evaluation plans mainly related to the realisation of tenant surveys.

The general advantage and the specific characteristic of the eSESH project is the combination of consumption measurement analysis on the one hand and tenant surveys on the other in order to quantify the impact of the eSESH EAS/EMS.

2.1 Methodology of consumption measurement analysis

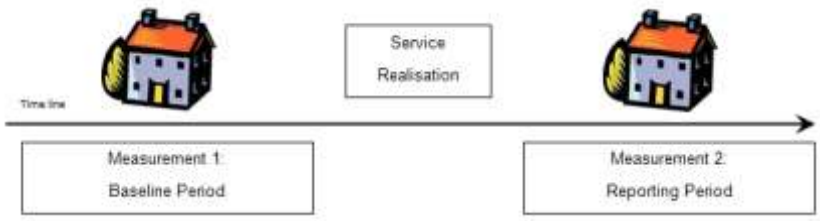
2.1.1 General eSESH approach

The general eSESH approach is oriented at the IPMVP (International Performance Measurement and Verification Protocol)[1]. In IPMVP, four options (A-D) are given for measurement and verification, but in the context of eSESH only option C is applicable. Principally, that is a pre-post-comparison (before and after an intervention, e.g. the implementation of an ICT-based consumption feedback solution as eSESH EAS/EMS) using prior consumption for an estimation of "non-intervention consumption". An additional or alternative calculation model is a control building/control group approach. That is appropriate when no baseline energy consumption data are available.

Pre-post-comparisons

In order to calculate changes in energy consumption in consequence of an intervention (e.g. EAS or EMS) a comparison of measured energy consumption data before (baseline period) and after the intervention start (reporting period) is useful. Of importance is to ensure that comparable baseline consumption data are available. In the best of cases both baseline and reporting period cover full operating cycles (e.g. one heating period or one year).

Figure 2-1: Before-after-analysis of one building



[1] see IPMVP public library of documents:

http://www.evo-world.org/index.php?option=com_content&task=view&id=272&Itemid=60&lang=en (Retrieved 20 March 2013)

Table 2-1: Units, frequencies of meter reading and periods according to energy type and pilot site

Site	Energy type	Unit	Frequency of meter reading	Baseline period	Reporting period
Angers	Water	l resp. m^3	hourly resp. monthly	01/01/2011-01/02/2012	01/02/2012-31/12/2012
	Electricity	kWh	10 min	control group approach is used	
Catalonia	Electricity	kWh	15 min	01/01/2011–31/12/2011	01/01/2012–31/12/2012
	Gas	kWh	daily resp.15 min	01/01/2011–31/12/2011	01/01/2012–31/12/2012
	Heating/DHW	kWh	15 min	01/01/2011–31/12/2011	01/01/2012–31/12/2012
	Solar energy	kWh	15 min	01/01/2011–31/12/2011	01/01/2012–31/12/2012
Extremadura	Electricity	kWh/ 15min	Olivia	01/06/2011–31/01/2012	01/02/2012–31/12/2012
			Badajoz	01/01/2011–30/11/2011	01/12/2011–31/12/2012
			Miajadas	01/07/2010–01/12/2010	01/01/2011–31/12/2012
			Pallares	01/01/2011–31/01/2012	01/02/2012–31/12/2012
Frankfurt	Heating & Hot water	kWh	half-hourly	01/02/2009 – 31/12/2011	01/01/2012–31/12/2012
	Cold water	m^3	half-hourly	01/02/2009 – 31/12/2011	01/01/2012–31/12/2012
Karlsruhe	Heating (flats)	kWh	monthly	01/01/2009-0109/2010	01/09/2010-31/12/2012
	Heating/DHW (building)	kWh	15 min	n/a	10/2010-12/2012
	Hot/cold water (flats)	m^3	monthly	01/01/2009-0109/2010	01/09/2010-31/12/2012
Linz	Heating	kWh	daily resp. individually	01/07/2011–31/12/2011	01/01/2012–31/12/2012
	Electricity	kWh	daily resp. individually	01/07/2011–31/12/2011	01/01/2012–31/12/2012
Moulins	Hot / cold water	m^3	hourly	01/01/2010–31/12/2011	01/01/2012–31/12/2012
Solingen	Heating	kWh	hourly	01/06/2010 – 31/03/2011	01/04/2011 – 31/12/2012
North Italy	District Heating	kWh	twice per year	16/10/2009–16/10/2011	16/10/2011–16/04/2012
	Hot/ cold water	m^3	twice per year	16/10/2009–16/10/2011	16/10/2011–16/04/2012
	Electricity	kWh	twice per year	16/10/2009–16/10/2011	16/10/2011–16/04/2012
	Gas	Nm^3	twice per year	16/10/2009–16/10/2011	16/10/2011–16/04/2012
	Space heating	kWh	monthly	16/10/2009–16/10/2011	16/10/2011–16/04/2012
	Hot water	kWh	monthly	16/10/2009–16/10/2011	16/10/2011–16/04/2012
Westerlo	Electricity	kWh	15 min	01/01/2011–31/12/2011	01/01/2012–31/12/2012
	Heating (Gas)	kWh	min. daily	01/01/2011–31/12/2011	01/01/2012–31/12/2012

As the above table shows, all pilot sites realised consumption measurements which allow pre-post-comparisons. The reporting period usually covers one year (2012). In single cases (North Italy, Angers, sub-sites of Extremadura) a shortened period with at least six month, but mostly 11 month has been taken as basis for calculation. Comparable baseline periods were available for all pilot sites.

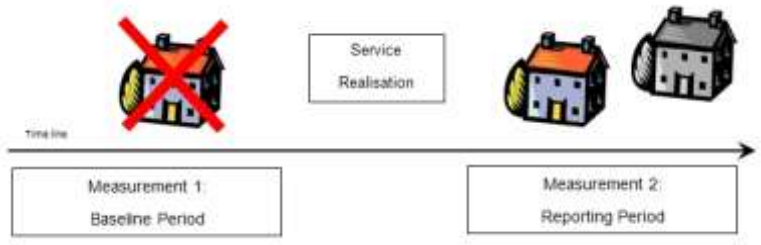
Depending on energy type the measured consumption data have been analysed related to the dwelling size (m^2) and/or the number of persons in the dwellings.

In addition to that temperature adjustments have been carried out when comparing the heat energy consumption within different heating periods in order to subtract out climatic effects. In doing so, different methods are known. As a standard practice, which is used within the EU member states, a heating degree day calculation model (HDD) has been used. The HDD have been calculated based on provided temperature data by weather services of the several countries. Despite methodological differences[2], a degree-day-correction generally allows comparisons of consumption data related to several time-periods (e.g. years, heating periods) – regardless of the diversity of climatic conditions of these measurement periods, of the location of the settlement/building, etc. By using those correction models it is possible to measure differences in consumption figures on a percentage basis, whatever the references are – referred to one and the same building in several heating periods, comparisons of various buildings or projects in the same or several years, etc.

Comparison with control building/control group

Even if less or no convenient baseline energy consumption data are available – especially in cases of new constructions or extensive refurbishments a control building design allows getting comparable energy consumption data. A control building is a similar building which matches the characteristics of the experimental building (e.g. kind of building, location, equipment, insulation, heating system, relation of public and private areas) as best as possible, but is – for example – not equipped with an energy management system.

Figure 2-2: Control building design



The same applies similarly to a control group of tenants. While one group of tenants – for example – makes use of consumption feedback via web portal (experimental group), the tenants of the control group living in the same or a very similar building do not have an access.

The advantage is – as its name implies – that the impact of an intervention can be controlled for other influencing effects. In the best of cases the only difference between both experimental and control building/group is the availability resp. absence of an intervention.

A control building approach has been used in Solingen regarding the evaluation of the impact of the central EMS. A predefined control tenant group exists in Linz.

[2] Different are – for example – the heating limit temperatures: Germany 15°C (low energy houses 12°C, passive houses 10°C); Belgium 16.5 °C; France 18 °C.

2.1.2 Data provision and data cleansing procedures

The data provision has been realised by the pilot site managers using a standardised evaluation template (MS Excel format) which includes:

- an INFO sheet collecting dwelling numbers/tenant IDs, dwelling and household size, number of rooms in the dwelling, change of tenancy/move-in date and the results of the tenant surveys following a standardised code plan
- a Consumption data sheet separately for all measured energy types related to the eSESH service (separately for EAS and EMS if applicable)
- a Service use sheet which collected the measured web portal log-ins.

At most of the sites the reporting period ended with the year 2012 so that the latest data updated has been carried out in January 2013.

To ensure the conclusion that energy savings are (mainly) caused by the eSESH service provided and not by 'disturbing factors' all conditions influencing the energy consumption (e.g. heat system, tenants) beside the services have to be identical in both baseline period and reporting period. Characteristic for several pilot sites in the eSESH project context is a high fluctuation rate. The energy consumption of tenant households is influenced by various aspects (behaviour, available appliances, etc.) and strongly varies between different households. That's why all consumption data sets have been put through a data cleansing procedure. That means dwellings with change of tenancy in the project duration were excluded from the data analysis. The same applies to (temporarily) unoccupied dwellings or long periods of absence of the tenant (zero values) and to cases with obvious inconsistencies in the measurements (e.g. implausible or extreme values due to malfunctions of the metering devices). In spite of this cleansing step, a lot of parameters have an influence on the datasets and it was not possible to take into account all of them. As a consequence, the analysis that is done has to be considered with caution. The focus must be put on the global trends; indeed, some particular points might not be representative and can have a slight impact on the global results.

However, as the following overview table shows approx. 2,200 pilot dwellings (different for various energy types) have been included in the consumption data analysis regarding EAS. That equates nearly 60% of the total number of about 3,700 pilot dwellings.

Regarding EMS always the whole number of pilot dwellings (if not otherwise stated in the pilot site specific chapters) has been the basis for the analysis.

Moreover, comparisons have been made with national averages. These national values come from the Odyssee database (http://www.odyssee-indicators.org/), the Eurostat database (http://epp.eurostat.ec.europa.eu/) and databases published by the French Authorities (and in particular the former French Institute of Environment).

Table 2-2: Overview of the total number of pilot dwellings and the number of dwellings included in the consumption data analysis

Site	Pilot site name	Number of buildings involved	Total number of dwellings involved	Number of dwellings included in consumption data analysis (EAS)	Data cleansing impacts (in terms of percentage of dwellings deleted)
Angers	Millot	25	28	Cold water: 444 Domestic hot water (DHW): 404 Electricity: 426	Change of tenancy: Cold Water: -15% DHW: -15% Electricity: -3% Periods of absence or inconsistencies: Cold Water: -14% DHW: -20% Electricity: -15%
	Haut de Chêne		68		
	Brissac		55		
	Mongazon		107		
	Eventard		138		
	La Roseraie		597		
Catalonia	Clota	1	53	Electricity: 44 Gas: 38	Change of tenancy: Electricity: -43% Gas: -42% Periods of absence or inconsistencies: Electricity: 0% Gas: -6%
	Cordoba I	1	18		
	Cordoba II		4		
	Cordoba III		2		
Extremadura	Miajadas	41	17	Electricity: 78	Change of tenancy: Electricity: -13% Periods of absence or inconsistencies: Electricity: -19%
	Pallares		10		
	Oliva de la Frontera		28		
	Badajoz		61		
Frankfurt	Stadtallendorf	4	90	Heating/DHW: 149	Change of tenancy: Heating/DHW: -9% Periods of absence or inconsistencies: Heating/DHW: -29%
	Eschwege (Oderstraße)	15	152		
	Eschwege (Lindenweg)[3]	19	116		
Karlsruhe	Rintheim	17	533	Heating: 323 DHW: 260 Cold water: 255	Change of tenancy: Heating: -24% DHW: -30% Cold water: -30% Periods of absence or inconsistencies: Heating: -8% DHW: -1.3% Cold water: -2.6%
Linz	Laskahofstraße	1	90	Electricity: 166 Heating: 159	Change of tenancy: Electricity: -3% Heating: -3% Periods of absence or inconsistencies: Electricity: -14% Heating: -12%
	Bäckerfeld	1	59		
	Donaupark	3	204		
	Riegelstraße	1	8		
Moulins	Les Chartreux	6	399	DHW: 342; Cold water: 348	Change of tenancy & Periods of absence or inconsistencies: DHW: -13% Cold water: -14%
Solingen	Pommernweg	31	296	Heating: 166	Change of tenancy: Heating: -23%

[3] related to EMS only

Site	Pilot site name	Number of buildings involved	Total number of dwellings involved	Number of dwellings included in consumption data analysis (EAS)	Data cleansing impacts (in terms of percentage of dwellings deleted)
					Periods of absence or inconsistencies: Heating: -21%
North Italy	Brescia	17	328	Electricity: 253 Gas: 480 District heating: 95 Water: 340 (The measurements are very differentiated by energy use; see chapter 4.9):	Change of tenancy: -2.5%
	Piacenza	3	92		
	Fano	3	48		
Westerlo	Netestraat	1	1	Electricity: 30 Heating: 44	Change of tenancy: Electricity & Heating : -14.5% Periods of absence or inconsistencies: Electricity: -31% Heating: -5.4%
	Schransstraat	5	53		
	Kapelaan Francklaan	8	67		
Dwellings in total			**3,722**[1]	**ca. 1,800-2,200**	

[1] including pre-defined control group

2.1.3 Calculation and presentation of savings

As above described, predominantly pre-post-comparisons have been used for calculating the savings. Dwelling sizes and household sizes have been taken into account in these calculations as well as temperature adjustments where appropriate.

Beside the calculated percentages of global energy savings related to the whole cleansed consumption datasets and related to all available energy types, the below analysis chapters provide further reference values for interpretation, e.g.:

- Background information on average surface areas and average household sizes
- Global figures of total consumption in relevant units (kWh, m^3) before and after the implementation of the eSESH service
- Global values of savings in kWh/a (if applicable HDD corrected) or m^3/a as basis for
  - Carbon dioxide reduction in $kgCO_2$/a (carried out with eeMeasure)[4]
  - Savings in €/a (carried out with eeMeasure)
- Average consumption per dwelling and year compared to the annual national average
- Savings, CO_2 reductions and monetary savings per pilot dwelling.

Of special interest were furthermore user/non-user-comparisons related to EAS use. As described in the introduction, the eSESH services were embedded in awareness campaigns realised by the pilot sites. So the EAS mostly cannot be assessed in isolation resp. there is an immanent bias

[4] eeMeasure is an energy saving calculation and measurement tool developed for the European Commission. It enables ICT PSP projects to calculate and record energy saving results using a consistent methodology. In turn this enables the European Commission and other interested parties to produce a better quantitative analysis of the energy savings potential of ICT based solutions in residential and non-residential buildings (http://eemeasure.smartspaces.eu/eemeasure/generalUser/)

caused by the fact that also non-users (e.g. because of missing internet access) were beneficiaries of these campaigns when participating in tenant events or trainings or when visited by an energy coach. Nevertheless, by taking that into account, related to all pilot sites comparisons of users and non-users have been carried out. In doing so, tenants who use the eSESH service more or less regularly (limiting criterion: logged-in at least once) were users if not otherwise specified. Tenants without service use were non-users. The log-ins to the web portals have been counted by special software and were assigned to pilot dwellings by following a tenant ID approach.

The presentation of user/non-user comparisons is very similar to the above described global result presentation.

When analysing the consumption data it became furthermore obvious that these data often allow additional comparisons between high and low consumers, heavy and weak service users, single- and multiple-person households. Where appropriate, such results have been included in the report in order to improve the findings.

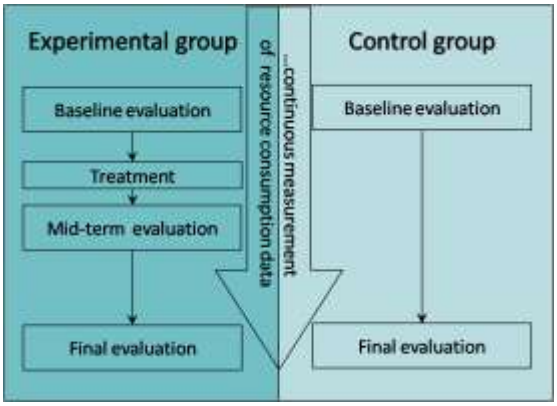
2.2 Methodology of tenant surveys and analysis

2.2.1 General eSESH approach

As described in the evaluation planning deliverable, the inclusion of the tenant's perspective into the impact analysis consolidates the findings by providing information of tenant's satisfaction with the eSESH service, reported energy-related attitudes or energy consumption behaviour patterns, socio-demographic characteristics and so on. The purpose of investigation in tenant's behaviour and attitudes is to increase the knowledge about the tenant population as the most important basis for target-group-specific strategies. Feedback approaches are more effective when combining continuous frequent consumption feedback with additional energy-related information and when fitting exactly the needs of target groups.

The ideal-typical tenant-related evaluation approach – as drafted in the Description of Work (DoW, task T7.1; see evaluation planning deliverable D7.1) – followed a quasi-experimental design including a three-stage data collection. In addition to that, the continuously measured energy consumption data should be allocated to the survey respondents by using a tenant identification code (tenant ID).

Figure 2-3: Ideal-typical tenant-related evaluation approach



For that purpose all pilot sites carried out at least one tenant survey[5]. Seven pilots realised a baseline survey as well as a final survey at the end of the reporting period. As the following table shows, in both stages nearly the same number of respondents could be achieved in all phases: More than 500 of the total number of about 3,700 pilot tenants participated in, which equates a response rate of 14%. The comparably low sample sizes in Angers and Karlsruhe – compared to its large number of pilot dwellings – are due to its special approaches: Angers combined the more qualitatively oriented survey with the visits of an energy-coach. Karlsruhe asked only pilot tenants for participation who attended the 'Service Hours' of the housing provider. When leaving aside these very specific pilot sites the response rate related to the remaining partners accounts to 24%.

Table 2-3: Overview of tenant survey sample sizes

	Baseline tenant survey		Final tenant survey		Longitudinal sample
	Absolute number of respondents	Percentage of total number of tenants	Absolute number of respondents	Percentage of total number of tenants	Absolute number of respondents
Angers[1]	40	4%	10	1%	7
Catalonia[2]	31	44%	25	35%	15
Extremadura	78	67%	71	61%	62
Frankfurt	57	24%	13	5%	3
Karlsruhe[3]	26	5%	-	-	n/a
Linz	81	22%	64	18%	18
Moulins	114	29%	134	34%	15
Solingen	-	-	41	14%	n/a
North Italy	105	22%	151	32%	59
Westerlo	-	-	17	31%	n/a
Total	**532**	**14%**	**526**	**14%**	**179**

However, the nearly same response rates in both stages didn't lead to a comparably high number of tenants in the longitudinal sample. In total, 179 pilot tenants participated in both stages of the realised tenant surveys. The reasons for drop-out were as follows: In general it is known that social housing tenants belong to a 'difficult-to-reach' population without pronounced willingness to participate in tenant surveys. This can be due to privacy concerns, to language barriers or simply to absent interest in filling-in a questionnaire.

That is also the reason, why all those pilot sites, which originally planned a three-stage panel, decided – based on the experiences of the baseline survey – to skip the mid-term survey and to lay all effort in the final one by involving a as large as possible number of pilot tenants in the survey.

In order to standardise the questionnaires a compilation of questionnaire modules for use by pilot sites has been provided within the evaluation planning. In these five main issues were addressed:

[5] In deviation to former plans also the pilot site Solingen decided to carry out one tenant survey due to the above described reasons.

1. Socio-demographic characteristics of tenants
2. Energy consumption behaviour
3. Attitudes and knowledge
4. User acceptance concerning consumption feedback services
5. Interest in the service and reasons for non-usage.

Based on that, the pilot sites had the opportunity to take all aspects of interest into account. In the best of cases parts of the questionnaires have been used in both stages in order to allow pre-post-comparison.

Based on the experiences of the realised tenant surveys it can be suggested (to projects with similar approach and content) to put all effort in one tenant survey at the end of the reporting period and to include questions related to a retrospective perspective. As the sample sizes in the above table shows, 879 of the total pilot tenants were willing to participate in one single survey which equates a much higher response rate of 24%.

2.2.2 Methods of survey analysis and presentation

The tenant survey data have been provided from each pilot site using the above described standardised evaluation template. For analysing the surveys the data have been imported in statistical software (SPSS).

In the following pilot site-specific chapters all information gathered within the tenant surveys is presented. In the best of cases the tenant survey analysis allows a description of socio-demographic characteristics of the respondents, pre-post comparisons of energy knowledge, attitudes and consumption behaviour patterns related to eSESH service users as well as user/non-user comparisons in relation to measured savings and/or measured consumption data.

3 Overall eSESH project results

The evaluation planning deliverable D7.1 described key issues of the pilot success and how these correspond to the given objectives in terms of the expected outcomes and impact of the ICT PSP Work Programme 2009 (Objective 4.1). According to the Description of Work the evaluation criteria were drawn up based on service, user and organisation requirements. In summary the impact analysis in eSESH was defined by answering the following main questions measuring the level of improvement achieved by the use of ICT for energy efficiency in social housing:

- Do the pilot sites meet the self-defined energy saving targets described in D7.1? Do these savings correspond to the 15% energy savings resp. 20% less CO_2 emissions target according to the objective 4.1 of the ICT PSP Work Programme 2009?
- Do the pilots reach a significant number of users?
- Are the provided ICT services an appropriate instrument to empower social housing tenants to increase energy efficiency at a high level? That means for example, are increased awareness or significant consumption-behavioural changes measurable as a consequence of the usage of the services?

Further pilot success criteria were related to the questions whether the eSESH service is viable in terms of costs and benefits and could the ICT services be operated with success. Both questions have been answered in the separate deliverable D8.2 resp. D6.1.

As described above the EAS and EMS services have been addressed to more than 3,700 dwellings whereof more than 2,200 dwellings could be analysed in the cleansed data sample. The buildings involved represented either the typical social housing building stock of a housing provider or – in the case of new constructions or extensive refurbishments – new energetic (building) standards whose ability for a future renewal of the property were to be tested.

Achieved global savings

The following table provides an overview of the calculated savings in the eSESH project compared to the target-setting of each pilot site done in the evaluation planning (see evaluation planning deliverable D7.1).

Seeing the fact that all pilot sites embedded the eSESH service in more or less holistic energy awareness campaigns, the achieved savings have been related to the total number of dwellings in the cleansed consumption dataset. As the table further below regarding active eSESH service use shows, of course, not all pilot tenants became regular users of the EAS tenant portal. Nevertheless, also tenants without possibility or willingness to use the internet have been motivated by other instruments to save energy.

The results of the eSESH service embedded in particular tenant approaches and motivation strategies speak for themselves: As the overview table shows, all ten pilot sites achieved savings. The majority of pilot sites achieved the saving targets defined in the evaluation planning deliverable, some at least partially. In several cases the achieved savings have reached beyond the above expectations. In the case of Westerlo it has to be kept in mind that the pilot site decided to focus on high consumers only because the average consumption of the pilot dwellings is already

much lower than the Belgian average energy consumption. This also applies for other pilot sites and is always described in the following pilot site-specific sections.

In most cases (much) more than 50% of the involved pilot tenants achieved measurable savings which have been calculated in pre-post-comparisons. That is a very promising result especially against the background that social housing tenants often already consume less energy than 'average' tenants. On the contrary, their low incomes often limit the ability, for example, to replace old electrical appliances by energy efficient ones.

Calculating an average of these pilot-specific savings is not possible due to different local circumstances - e.g. due to divergent measured energy types in buildings with different energy efficiency categories (which – according to plan - has not been focussed on in the project) and as a result of that missing weighting possibilities, also related to the broad range of the number of pilot dwellings involved in the single pilot sites.

Related to the eSESH project as a whole, more than 134 tons CO_2 emissions per year could be saved. And this amount does not yet include the 17% savings of CO_2 emissions calculated by Voltalis resulting from electricity load shedding in Angers. In fact the percentage of CO2 savings are the same as for energy (as the CO2 savings are obtained by multiplying the savings in kWh by a coefficient, apart from load shedding for which it is different), but, as for energy, the percentages can't be summed.

Table 3-1: Overview of global results including calculated savings and reduced CO_2 emissions

Pilot site	Energy type	Savings target in % (taken from D7.1)	Percentage of achieved global savings	Percentage of pilot dwellings with savings	Reduced CO2 emissions in kgCO2/year
Angers[1]	Electricity (EAS)	5%	5.7%	n/a	1,331
	Electricity (EMS, load shedding)	5% electricity savings implies a 15% reduction of peak consumption	5%	related to all 60 equipped pilot households	17% savings of CO_2 emissions
	Hot water (EAS)	overall 10%	3.1%	50%	n/a
	Cold water (EAS)		4.1%	56%	n/a
	Heating (EMS)		12.6%	related to all 597 pilot dwellings in La Roseraie	41,500
Catalonia[2]	Heating (EAS)	10% (up to 20%)	32.3%	90%	14,176
	Electricity (EAS)		5.8%	73%	2,797
Extremadura	Electricity	12%	11.5%	80%	13,764
Frankfurt[3]	Heating/DHW (EAS)	up to 15% (active users)	4.1%	53%	8,518
	Heating/DHW (EMS)	10%	9%	related to all 358 pilot dwellings	4,400
Karlsruhe	Heating (EAS)	10% (up to 25%)	14.3%	63%	15,582
	Hot water (EAS)		5.6%	55%	n/a
	Cold water (EAS)		2.1%	50%	n/a
Linz[4]	Heating	overall 5%	6.5%	63% (EAS), 90% (EMS)	2,536
	Electricity		4.7%	60 % (EAS), 68% (EMS)	3,479
Moulins	Hot water	17%	24.3%	76%	n/a
	Cold water		12.5%	70%	n/a
Solingen[5]	Heating (EMS)	overall 15%	30%	related to all 296 pilot dwellings	n/a
	Heating (EAS)		increase of 1.2%	47%	n/a
North Italy	Electricity (EAS)	overall 10%	4.5%	50%	12,826
	Gas (EAS)		6.6%	60%	23,775
	District heating (EAS)		4.15%	58%	597
	Water (EAS)		5.6%	55%	n/a
	Electricity (EAS)	7-10%	-	40%	n/a
Westerlo	Heating (EAS)	9-13%	6.6%	50%	2,857
Total				**40% -100%**	**134 tons/a[6]**

[1] Angers: The calculation of electricity savings was based on a control-group approach because no baseline data were available. The load shedding results has been provided by Voltalis.

[2] Catalonia: The high energy savings target of more than 10% is only related to six dwellings in the Cordoba building.

[3] Frankfurt: As the below detailed pilot analysis will show, the EMS savings are related to DHW savings in summer month only.

[4] In Linz the eSESH service contains an EAS as well as an EMS which is also used by tenants.

[5] In Solingen the EMS analysis was based on a control group approach with similar settlements because of missing useful baseline data due to extensive refurbishments prior the eSESH project. In addition to that the heating system contains of a wood chip boiler with nearly zero CO_2 emissions compared to fossil systems.

[6] Without the analysis carried out by Voltalis describing 17% CO_2 savings related to load shedding in Angers

Achieved number of EAS users

As the following table shows, 2,666 tenant households (= 5,865 individuals; average household size 2.2 as described in DoW) are potential EAS users[6]. That means that they have been equipped with the eSESH service and could make use of it. Compared to the work plan, the target of 5,512 tenants provided with EAS has been overachieved. One third of the total number of potential users became actual users of the EAS tenant web portal. That information has been gathered from the portal log-in file at all pilot sites. When considering also tenants who registered to the portal but did not start to use and/or those who received postal information and/or were involved in energy coaching the percentage of interested tenants is significantly higher (40%).

Table 3-2: Overview of the number of users (tenant households)

	Potential EAS users	Actual registered tenants interested in eSESH (also beside internet use)	Active EAS tenant portal users measured by portal log-ins	Percentage of active EAS users compared to potential users
Angers[1]	938	203	132	14.1%
Catalonia[2]	71	51	54	76.0%
Extremadura	116	106	70	60.3%
Frankfurt[3]	242	33	33	13.6%
Karlsruhe[4]	(533)	(27)	(27)	-
Linz[5]	82	79	52	63.4%
Moulins	399	198	198	49.6%
Solingen	296	204	189	63.8%
North Italy	468	151	81	17.3%
Westerlo[6]	54	45	30	55.6%
Total	**2,666**	**1,070**	**839**	**31.5%**

[1] Angers: related to EAS dwellings

[2] Catalonia: 6 dwellings stayed unoccupied during the eSESH project

[3] Frankfurt: related to EAS dwellings

[4] Karlsruhe: Because of technical problems the planned relaunch of the EAS is still outstanding. That's why Karlsruhe has not been considered in the total sum.

[4] Linz: The remaining dwellings compared to the total sample of 361 dwellings belong to the predefined control group. The active users contain 18 EAS web portal users and all 34 EMS users via iPod.

[6] Westerlo: The remaining 67 dwellings (Kapelaan Francklaan) were neither part of the consumption analysis nor part of the tenant survey analysis. That's why they are not considered here.

Compared to the target setting of 50% active users at the end of the project (related to performance monitoring indicators, see D7.5) six of the ten pilot sites (over)achieved that result. Related to Angers, Frankfurt and North Italy - where the goal seems to be underachieved – one has to be consider the specific characteristics of social housing tenants there with comparably lower internet access rates and low internet affinity especially of the elderly.

[6] Compared to the total number of 3,722 pilot dwellings this figure is without pre-defined control group (Linz) and the Karlsruhe tenants.

Achieved awareness increase and optimised energy consumption behaviour due to eSESH

The tenant questionnaires included questions regarding energy saving attitudes and energy awareness. In addition to that tenants reported on energy consumption behaviour related to preferred indoor temperatures, ventilation behaviour, use of electrical appliances, etc. That self-report could often be compared in pre-post comparisons or be measured in the final survey providing a retrospective perspective. The following table describes positive trends gathered from the survey analysis. The criteria-setting was as follows:

Energy awareness has been counted as 'High' if more than 50% of the respondents/EAS users:

- described their interest in consumption reduction and/or
- have a high 'energy saving norm' ('I think I should save more energy at home.') and/or
- keep an eye on their energy consumption.

The classification 'Medium' has been used if more than 50% of the respondents reported on better knowledge related to the possibilities to save energy while energy awareness or further energy-related attitudes were not known. The classification 'Low' was used if less than 50 % of the respondents reported on increased knowledge or attitudes.

Behavioural change is counted as '+' if tenants reported on optimised energy consumption behaviour in the final survey, as 'o' if no changes were obvious and as '-' if no optimisation of behaviour has been realised. In some cases a before-after-comparison was not possible because of the realisation of only one survey or missing information/question in the final survey ('n/a').

Table 3-3: Overview of basic tenant survey results related to increased awareness and reported energy consumption behaviour changes due to eSESH

	Raised energy awareness	Reported behaviour changes
Angers	high	+
Catalonia	high	+
Extremadura	high	+
Frankfurt	high	n/a
Karlsruhe	high	n/a
Linz	high	+
Moulins	medium	+
Solingen	high	+
North Italy	high	+
Westerlo	high	n/a

The above table shows in general very promising results. Respondents of nearly all pilot sites reported an increased energy awareness due the eSESH service and/or due to the overall energy awareness campaign. In seven of 10 pilots respondents reported on behavioural changes.

4 Pilot site-specific project results

4.1 Angers

4.1.1 Background information

The eSESH services are aiming at overall energy savings and fixed-time demand reduction with the consequent benefit of lowering contracted power in the future. The approach of the housing provider LTA is to propose an integrated service to tenants focusing on simple and client-friendly awareness services for tenants (EAS). This energy awareness service is implemented in the five pilot sites and is offered in an internet portal, but is also as a monthly energy report or by way of an energy coaching.

Figure 4-1: Screen shot of the Angers web portal

Concerning the energy management service (EMS), different functionalities have been developed because of specific heating systems:

- In La Roseraie, with a collective heating system, the management service is led by Effineo and consists of a heating regulation by the heating provider thanks to a dedicated portal (in this case the electric data collection for awareness is led by Effineo).
- In Millot, Brissac and Le Haut Chêne, with individual electric heating and boiler, the management service is led by Voltalis by load shedding.
- In Mongazon and Eventard, there is no energy management service developed.

Tenant recruitment in Angers was divided into several steps. The energy awareness campaign includes encounters at the tenant's home with an energy coach which had different aims:

- Give precise comparative analysis of the monthly energy budget and energy saving potential of the tenant
- Check the equipment referring energy class, options for programming

- Provide an analysis using the internet portal (behaviour linked to consumption, electric subscription)
- Give a training how to use the portal
- Define a strategy with the tenants how to reduce their energy consumption.

The energy coach has been associated during the conception and realisation of eSESH. Nevertheless she was specially trained to animate the individual encounters since February 2012. The energy coach was continuously available for interactive phone assistance (if necessary) to help tenants using the internet portal. All participating tenants were trained from February 2012 on.

In addition to that the “awareness game” was carried out in several meetings with groups of about eight tenants. With a board game, dedicated to energy and mostly water, the LTA informs the tenants how to improve their daily practice.

The first contact with the tenants was in November 2011 by letter. The letter contained the portal access code, information about the possibility to contact an energy coach, an invitation to the “awareness game” as well as information about a monthly brochure which contains the consumption of each flat. After sending this letter the energy coach collected the consumption data for each flat and the income of the tenants. This identified tenants who need the saved money most in order to develop a specific approach to work with them on saving energy. The energy coach then calls the tenants identified as “low incomes with high energy expenditures” who did not respond to the letter. Starting in February 2012 meetings between the respective tenants and the energy coach were taking place.

In addition, Angers also realised a monthly energy consumption personal report, which have been sent to tenants from March 2012 onwards. This report provides the consumption of the tenants - extract from the internet portal - and benchmarks the information.

In total, 993 dwellings located in 25 buildings at 5 sub-sites were involved in the pilot: 938 with EAS and 691 with EMS (94 load shedding, 597 heating management) as the following table shows.

Table 4-1: Overview of the number of buildings and dwellings involved in the Angers pilot

Site	Pilot site name	Number of buildings involved	Number of dwellings involved	Distribution of EAS and EMS related to dwellings involved
Angers	Millot	25	28	EAS n=28; EMS n=28 (load shedding)
	Haut de Chêne		68	EAS n=68; EMS n=11 (load shedding)
	Brissac		55	EMS n=55 (load shedding)
	Mongazon		107	EAS n=107
	Eventard		138	EAS n=138
	La Roseraie		597	EAS n=597; EMS n=597 (heating management)

At the beginning of the eSESH project Le Toit Angevin (LTA, social housing provider) contracted for 245 buildings composed of Eventard and Mongazon. But because of refurbishment with heating and boiler system modification the load-shedding device could not be implemented as planned. Consequently, LTA decided to add the Millot and Haut-Chêne sites to the pilot. In addition to that LTA added the Roseraie site to the eSESH pilot in order to increase the number of EAS users.

That decision was supported by LTA's interest to implement the service in five different kinds of site characteristics (new building, refurbished building, inhabited by students or 'classic' social housing tenants with different income level) which permit a complementary analyse regarding each context.

The following table provides a detailed analyse of the user profiles as well as of how the different energy saving tools have been used.

Table 4-2: Overview of the users of EAS and EMS per type (web, paper, energy coaching)

Angers pilots	Number of dwellings with installed monitoring connected to service	Number of dwellings provided with access to service (passwords)	Number of registered users (using the service at least once)
Millot	28	28	15 Differentiated in: - 15 internet portal users (average use frequency: 1.3 times)
Haut Chene	68	68	25 Differentiated in: -17 internet portal users (average use frequency: 2.6 times) - 3 energy coaching - 5 by monthly report
Roseraie	597	597	110 Differentiated in: - 61 internet portal users (average use frequency: 5.5 times) - 9 energy coaching - 36 by monthly report - 4 awareness meeting
Mongazon	107	107	43 Differentiated in: - 29 internet portal users (average use frequency: 3.2 times) -2 energy coaching - 19 by monthly report -1 awareness meeting
Eventard	138	138	10 Differentiated in: - 10 internet portal users (average use frequency: 1.6 times) -1 energy coaching - 6 by monthly report
Achieved number of dwellings	993	993	203 (that equates 568 individuals related to average household size of 2.8 persons)
Initially planned number of dwellings	245 in contract (292 in D7.1)	245 in contract (292 in D7.1)	245 (that equated 539 individuals based on an estimated average household site of 2.2 persons in contract; 292 individuals in D7.1;

Angers pilots	Number of dwellings with installed monitoring connected to service	Number of dwellings provided with access to service (passwords)	Number of registered users (using the service at least once)
			average household size of 1 person)

In total there are 203 users of the eSESH EAS which equates to 22% of the total number of pilot tenants. 132 tenants made use of the EAS web portal.

In the student residence Millot 53% of tenants connected to the portal, but only with an average of 1.6 times. The students, familiar with the use of new technology, seem to have a "gadget approach" of the portal.

In classical residences without too strong precariousness (Mongazon, Haut Chêne) the EAS use rate is important between 25 and 27%. The average use frequency is between 2.6 and 3.2 times.

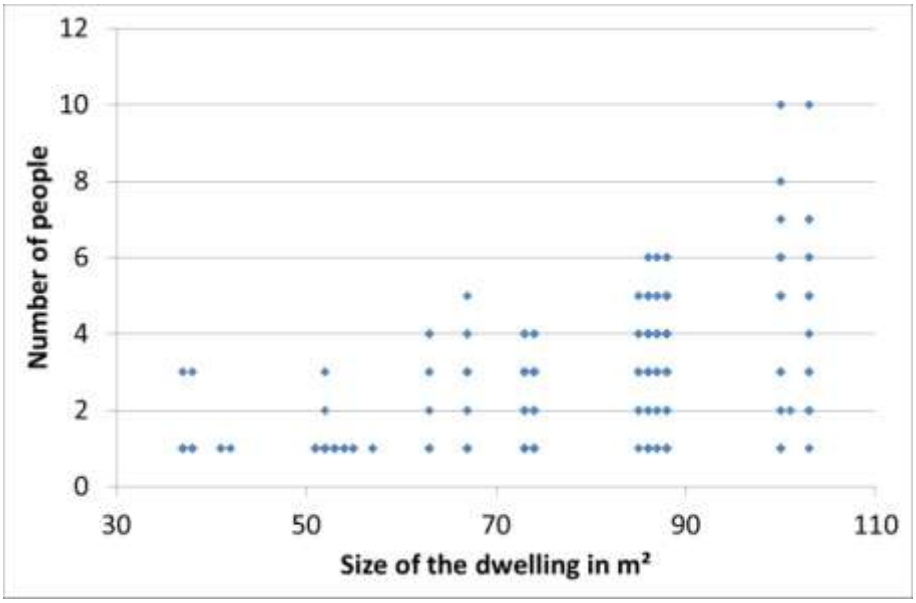
In residences with social difficulties marked (Roseraie, Eventard) the connection rate falls to 10 resp. 11.5% but with high frequency of use on average: 5.5 times in Roseraie. The low use frequency of Eventard portal (1.6 times) can be explained with the refurbishment in progress, which is the priority before saving energy by changing energy consumption behaviour.

4.1.2 Results of consumption data analysis

In Angers, 938 dwellings have been equipped with the eSESH EAS service. Nevertheless, the Eventard and Mongazon time operation was half as long as the Millot and Roseraie one. For this reason, and in order to carry out relevant analysis, it Angers decided to exclude Eventard and Mongazon from the analysis (245 dwellings) to concentrate on La Roseraie and Millot (625 dwellings).

The number of dwellings equipped is comparably high. As a consequence, the range of dwelling sizes and number of people is very wide (see the following chart). This diversification of the sample can explain bias in the analysis.

Figure 4-2: Number of people in the dwelling related to the size of the dwelling in m²



In Angers, cold and hot water as well as electricity have been measured. Electricity is used for different domestic usages: electrical appliances and lighting.

Before analysing the data, it was necessary to cleanse it in order to take into account the changes of tenancy which occurred during the project as well as some incoherencies or periods of absence of the tenants. In these cases the dwellings were excluded from data analysis.

A specific adaptation of the cleansing procedure has been adopted in the case of Millot. Millot is a residence for students and as a consequence nearly empty during summer. This vacancy of this building was taken into account in the cleansing step.

The dataset analysed represents nearly 70% of the whole dataset.

Table 4-3: Description of the cleansing step

Cleansing				
Data	Site	Number of dwellings		Approach
		Before cleansing	After cleansing	
Electricity	La Roseraie	597	426	Control Group Approach
Hot water	Millot & La Roseraie	625	404	Pre-post Comparison
Cold water	Millot & La Roseraie	625	444	Pre-post Comparison

As the above table further shows, two approaches have been used for calculating the savings:

- In the case of hot and cold water, a baseline and a reporting period were available which allowed a *pre-post comparison* based on the analysis of the evolution of the consumptions before and after the implementation of the service. The date of implementation of the service was February 2012. As a consequence, the pre-post comparison is based on a comparison between the period before February 2012 (01/01/2011 - 01/02/2012) as baseline period and the period after February 2012 (01/02/2012 - 01/12/2012) as reporting period.

- In the case of electricity a *control group approach* has been used as a consequence of the missing baseline. A control group approach is based on the comparison between two groups and requires two very similar groups. The first group neither has been equipped nor has been approached by the proximity teams whereas the second group has been provided with the eSESH service. The control group approach is based on a comparison between both groups during the year 2012.

Global Results of consumption data analysis (EAS)

The global calculation of savings is shown in the following table. Therefore, EAS users achieved nearly 6% electricity savings compared to the control group. About 3 resp. 4 % total savings have been observed for cold and hot water.

Hence, the in the evaluation planning defined saving target of 5% electricity (see deliverable D7.1) has been overachieved. The water saving target of 10% could not be fully met. But as the differentiated analysis below shows the water savings are much better (up to 30%) for tenants who often use the EAS tenant web portal.

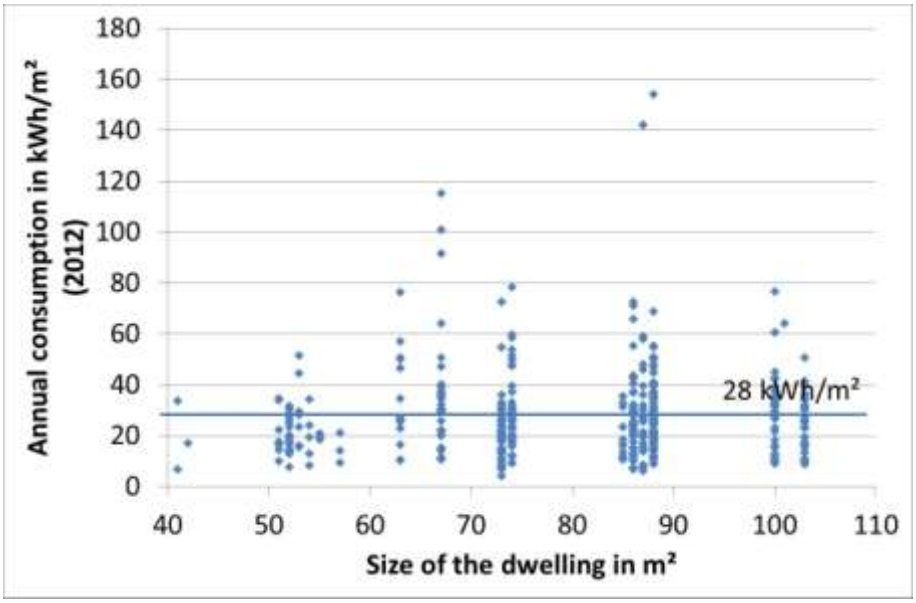
Table 4-4: Overview of global results in Angers (EAS)

Key data			
	Electricity	Hot water	Cold water
Number of dwellings	68	404	444
Surface area (average)	78	78	77
Number of people (average)	2,89	2,96	2,86
Global Results for the dataset of dwellings			
	Electricity	Hot water	Cold water
Savings (%) - eeMeasure (weighted)	5,70%	3,10%	4,10%
Saving (kWh/yr or m3/yr) - eeMeasure	9 667	398	1 008
Carbon Dioxide Reduction in kgCO2/yr - eeMeasure	1 411	-	-
Financial Saving (€/yr) - eeMeasure	1 373	3 185	2 873
Consumption Before Intervention (kWh/yr or m3/yr - average)	169 606	12 858	24 577
Results (per dwelling, per people or per m²)			
	Electricity	Hot water	Cold water
Consumption Unit	*(kWh/m².year)*	*(m3/m².year)*	*(m3/m².year)*
Consumption - Before intervention	28	0,41	0,71
Consumption - After intervention	-	0,39	0,68
Consumption Unit	*(kWh/dwelling.year)*	*(m3/people.year)*	*(m3/people.year)*
Consumption - Before intervention	2 174	11	19
Consumption - In the same country*	2814*	51	
Saving	142	0,33	0,79
Carbon Dioxid Reduction in kgCO2/dwelling.yr	21	-	-
Financial Saving (€/dwelling.yr)	20	8	6
** See references*			

Electricity

For electricity, it is important to compare the levels of annual electricity consumption per m². The graph below shows that the consumption of the dwelling is not correlated to its size due to the imponderables of any dwellings (TV, household appliances…).

Figure 4-3: Annual Electricity Consumption (in kWh/m²) related to the surface of the dwelling in m²



Domestic hot water (DHW)

Regarding hot water consumption there is a correlation between the annual consumption and the size of the dwelling obvious as the following both figures show.

Figure 4-4: Annual Consumption (in m3) related to the surface of the dwelling in m², in 2011

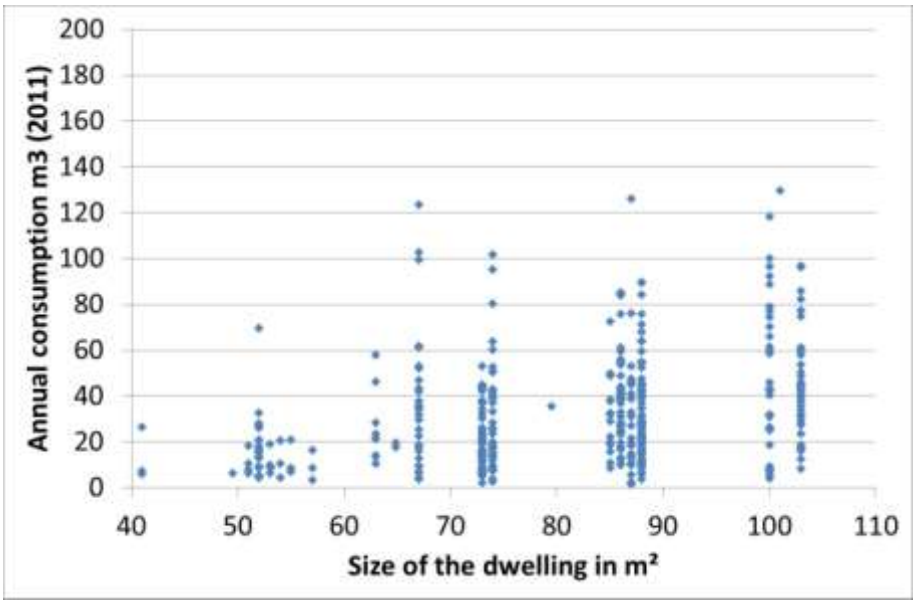
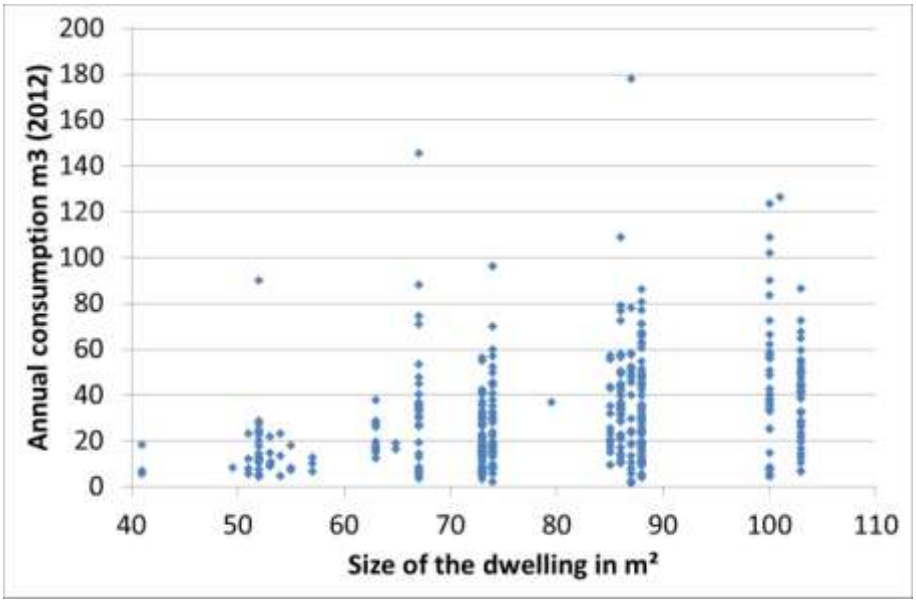
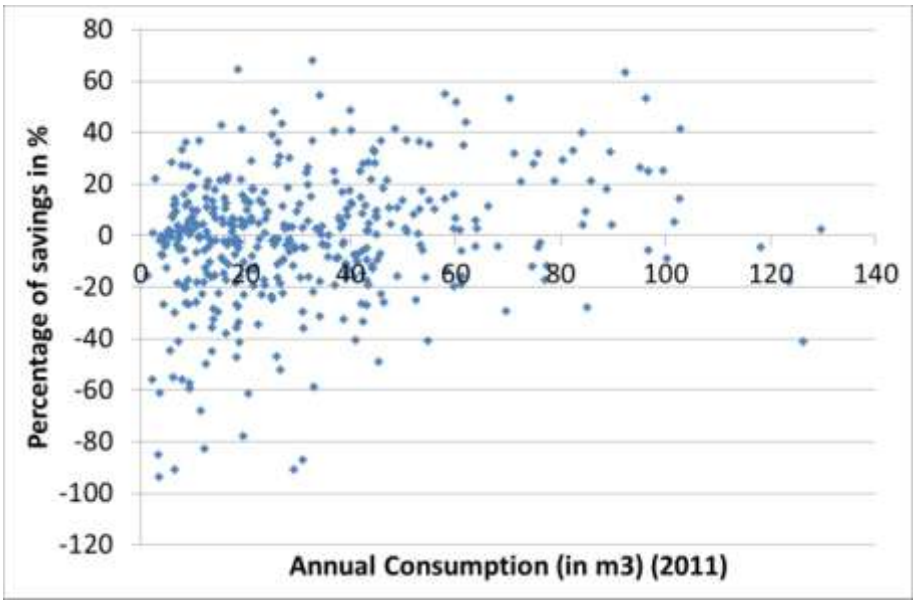


Figure 4-5: Annual Consumption (in m3) related to the surface of the dwelling in m², in 2012



Thanks to the following graph it can assessed that the majority of the dwellings (more than 50% of the tenants) made DHW savings, especially the high consumers. That is a good result even if the global savings is not very high - especially considering the fact that a lot of different dwellings (sizes, number of people…) have been addressed within the project.

Figure 4-6: Percentage of savings (+ values) related to annual consumption in m3



Cold Water

Regarding cold water consumption is also a correlation between the annual consumption and the size of the dwelling obvious. Nevertheless, this correlation is less stressed than that for hot water.

Figure 4-7: Annual Consumption (in m3/dwelling) related to the surface of the dwelling in m², in 2011

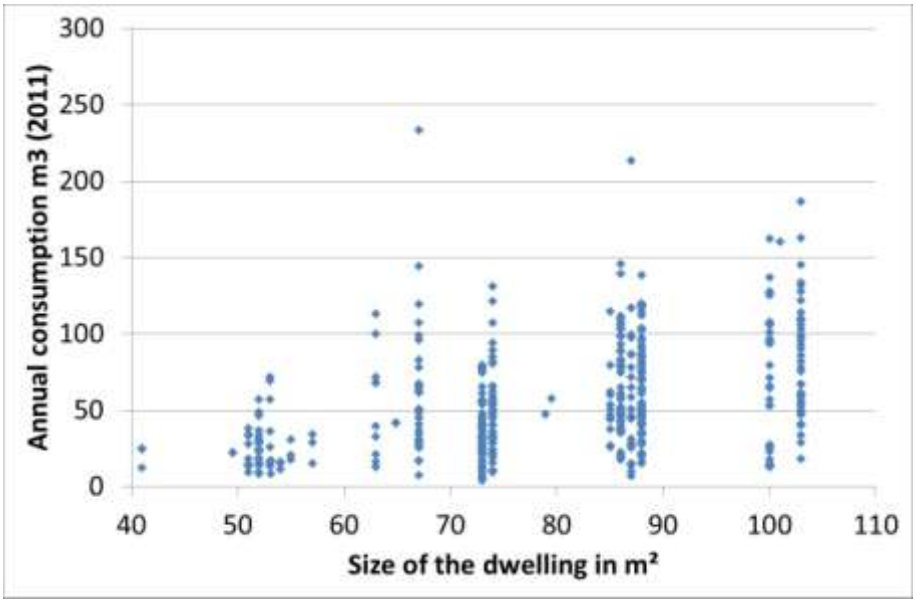
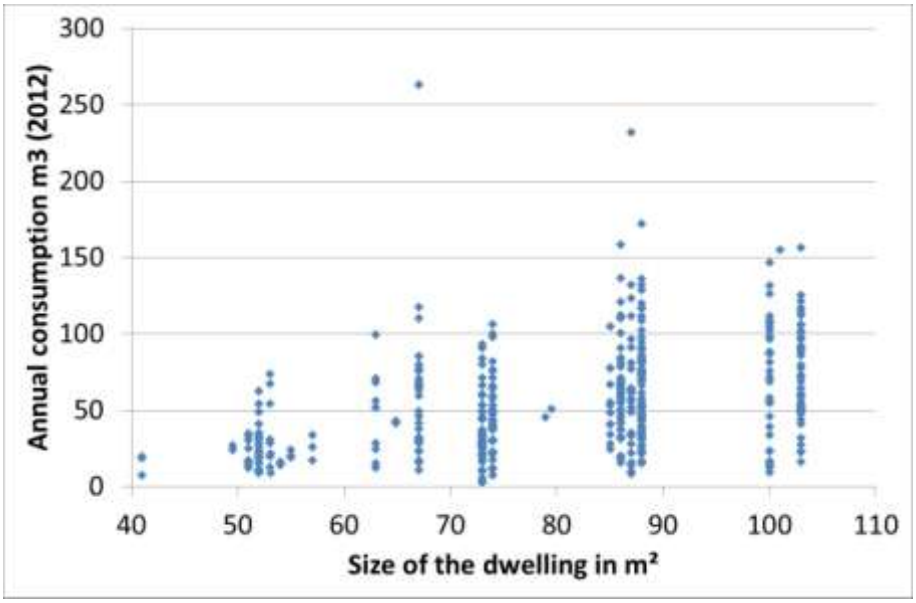
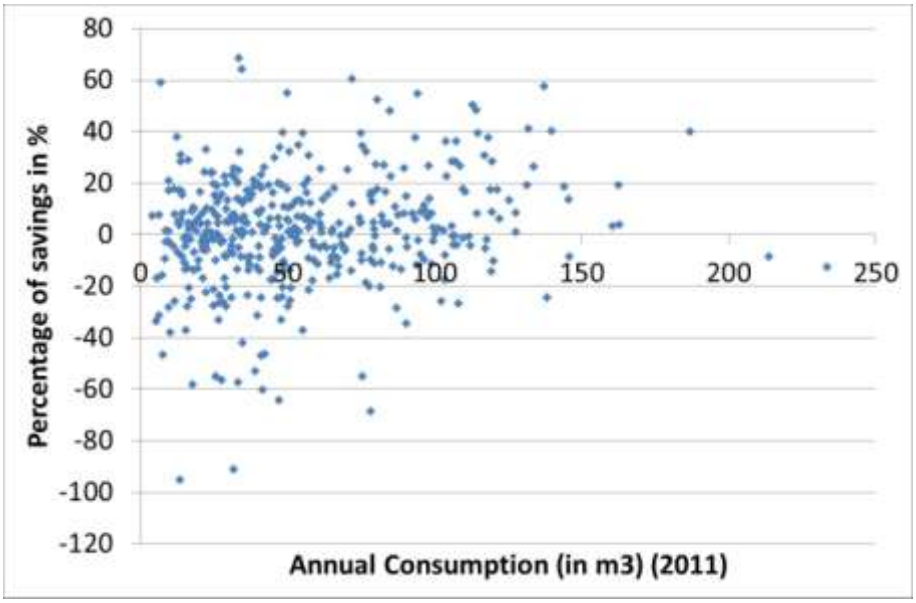


Figure 4-8: Annual Consumption (in m3/dwelling) related to the surface of the dwelling in m², in 2012



As for DHW it can be observed that a majority of the tenants achieved savings (56%) - again especially the high consumers – which is a promising result.

Figure 4-9: Percentage of savings (+ values) related to annual consumption in m3



Comparison between users and non-users

As described above a pre-post comparison for users and non-users is only possible for hot and cold water. Users are tenants who:

- Used the web portal (11% of the dataset) or
- Received the visit of an energy coach (2% of the dataset) or
- Received a monthly consumption feedback report (7% of the dataset) or
- Attended an energy activity organised by Le Toit Angevin (less than 1% of the dataset)

The remaining tenants were counted as non-users.

The portal use frequency is measured by special software so as among the web portal users different categories of users could be defined:

- The weak users who connected themselves to the site less than 6 times
- The moderate users who connected themselves between 6 and 20 times
- The Heavy Users who connected themselves more than 20 times

As the following table shows those ‘heavy users’ achieved much better results than weak users – more than 24% hot water savings and 6 % cold water savings. That can serve as a good indicator that the EAS in general is an appropriate instrument to raise awareness and to achieve significant saving results.

Table 4-5: Distribution of users, non-users and heavy users in the consumption dataset

Comparison between users and non-users					
		Hot water		Cold water	
Total of dwellings	Users	79	20%	86	19%
	Non Users	325	80%	358	81%
	Total	404	100%	444	100%
Surface per dwelling	Users	80,46		76,45	
	Non Users	77,94		77,70	
People per dwelling	Users	2,77		2,62	
	Non Users	3,01		2,92	
Average Annual Consumption 2011 (baseline period)	*Unit*	*kWh/(dw.year) in 2011*		*kWh/(dw.year) in 2011*	
	Users	30		52	
	Non Users	31		54	
% of dwellings which made savings	Users	48%		56%	
	Non Users	53%		56%	
	Total	52%		56%	
Savings (%)	Users	-2,00%		3,40%	
	Non Users	4,00%		5,60%	
Comparison between weak users and heavy users					
		Hot water		Cold water	
Total of dwellings	Heavy Users	4		5	
	Unit	*kWh/(dw.year) in 2011*		*kWh/(dw.year) in 2011*	
Average Annual Consumption 2011 (baseline period)	Heavy Users	23		53	
Savings (%)	Heavy Users	24,40%		6,00%	

Hot water

38% of the tenants who appear as users but did not use the EAS web portal (as defined above) made savings. Among the portal users this figure reaches 54% which is more than the global group. This figure is even better for moderate and heavy portal users: 75% of these tenants made savings, the savings for these users equal 24.4%.

Figure 4-10: Percentage of savings (+ values) related to the surface of the dwelling in m², for the different kinds of users for DHW

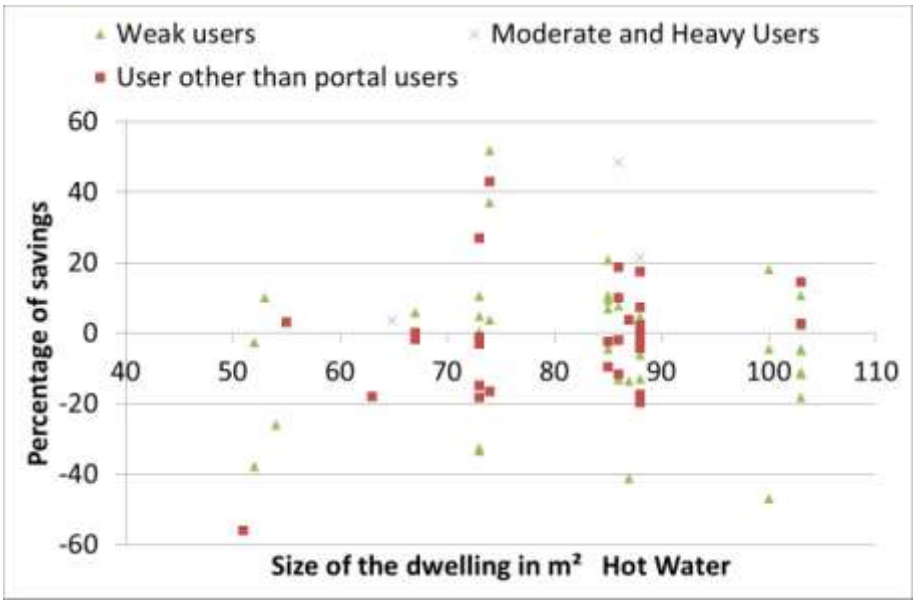
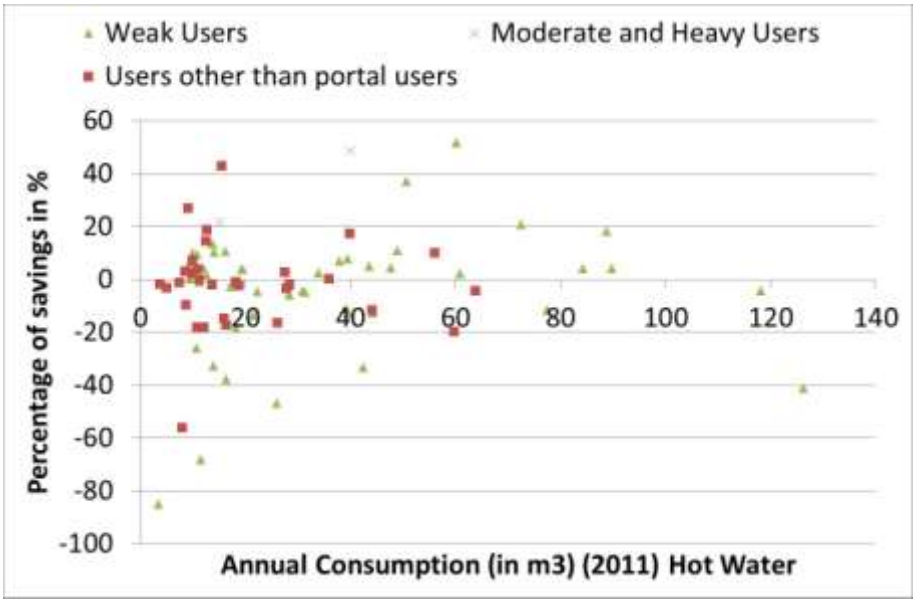


Figure 4-11: Percentage of savings (+ values) related to the annual consumption in m3, for the different kinds of users for DHW



Cold water

50% of the tenants who appear as users without EAS portal use made savings. Among the actual portal users this figure reaches 59% which is again more than the global group. This figure is even better for the moderate and heavy users of the portal: 90% of these households achieved cold water savings of 6%.

Figure 4-12: Percentage of savings (+ values) related to the surface of the dwelling in m², for the different kinds of users for cold water

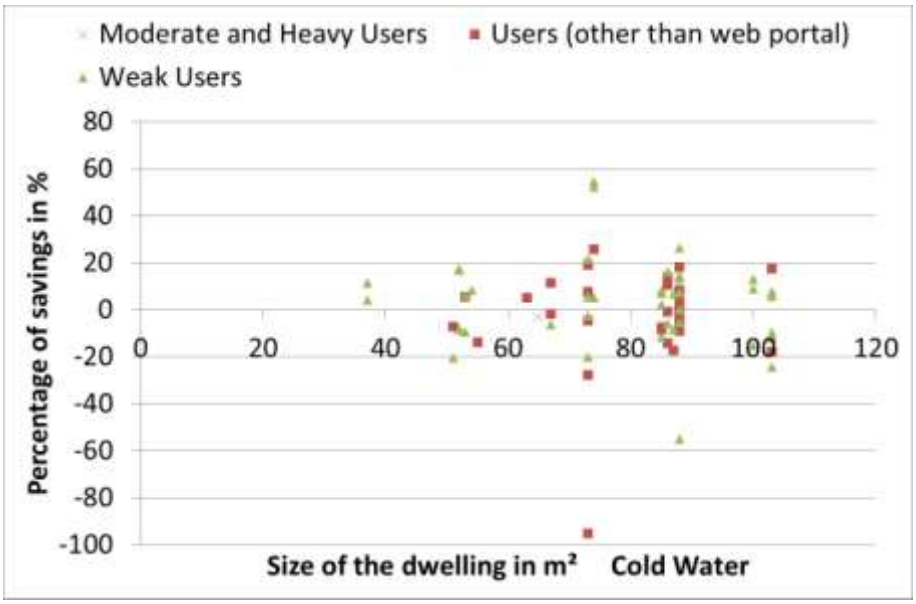
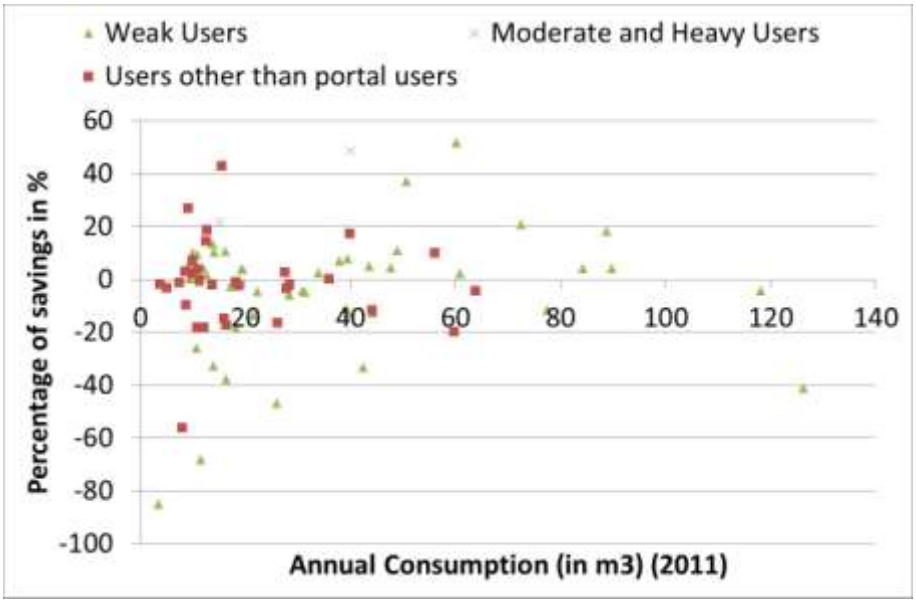


Figure 4-13: Percentage of savings (+ values) related to the Annual Consumption in m3, for the different kinds of users for cold water



Results of electricity consumption data analysis with load shedding (EMS)

In the context of the eSESH project in Angers 3 sites (around 60 households) were equipped with systems of load shedding by Voltalis: Millot, Brissac and Haut Chêne. This load shedding system consists in stopping the heating system during short periods and taking benefit of the inertia of heating in dwellings.

Voltalis calculated the energy savings and the savings in terms of CO2 enabled by this system. The savings in terms of CO2 include the heating cut-off and also the postponement of the production of domestic hot water during off-hours.

Three elements are involved in this calculation which is internal to Voltalis:

- Clearing (load shedding) raw energy is converted into CO2 avoided
- This effect is amplified by the reduction of line losses
- It also takes into account the fact that part of the energy saved by load shedding is not saved, but postponed so smooth on the total consumption, thus making use of low-carbon means, which is calculated as the load CO2.

Climat Mundi, a leading French Advise Company (with French ADEME Carbon calculation certification) whose expertise deals with greenhouse gas emissions and energy efficiency, worked on the system developed by Voltalis in order to assess its environmental footprint. Climat Mundi came to the conclusion that load shedding (answering the network balancing needs) enables to achieve a minus 7% of energy reduction for the fitted dwellings with Voltalis system and a minus 30% CO2 impact by avoiding the resort in fossils powerful capacities that are operating in case of a lack of energy in the network.

Based on the dwellings involved in the eSESH project, the results obtained are:

- 5% of energy savings and,
- 17% of CO2 emissions savings.

Different reasons can explain these differences. Among them is to be noted:

- missing data due to a phenomenon of vacancy, especially in Millot, which is a student building and therefore is empty during holidays
- Differences in the rhythms of load shedding by Voltalis between the experimentation made by Climat Mundi and the follow-up of the households of the project.
- Differences in the values of carbon/kWh between the project and Climat Mundi.

The graph which follows presents the evolution of these savings from October 2010 until December 2012.

Results of heating consumption data analysis (EMS)

A described in the above introduction, different functionalities concerning the energy management service (EMS) has been developed. In La Roseraie, the EMS is based on the collective heating system. The management service is led by Effineo and consists of a heating regulation by the heating provider thanks to a dedicated portal.

As shown in the following graphs, beginning from the date of implementation of the service (February 2012), except for the month October 2011 and December 2011, the consumption is significantly reduced compared to the same months of the previous years. This decrease leads to a global savings of 12.6%. Compared to the target setting of 10% savings (see evaluation deliverable D7.1) this result is an absolute success.

For a normal year (HDD corrected value) and for the set of buildings considered, this percentage corresponds to a global saving of 520 MWh and more than 41,500 kgCO2.

Figure 4-14: Consumption (HDD corrected values) per group of buildings, from October 2010 to December 2012

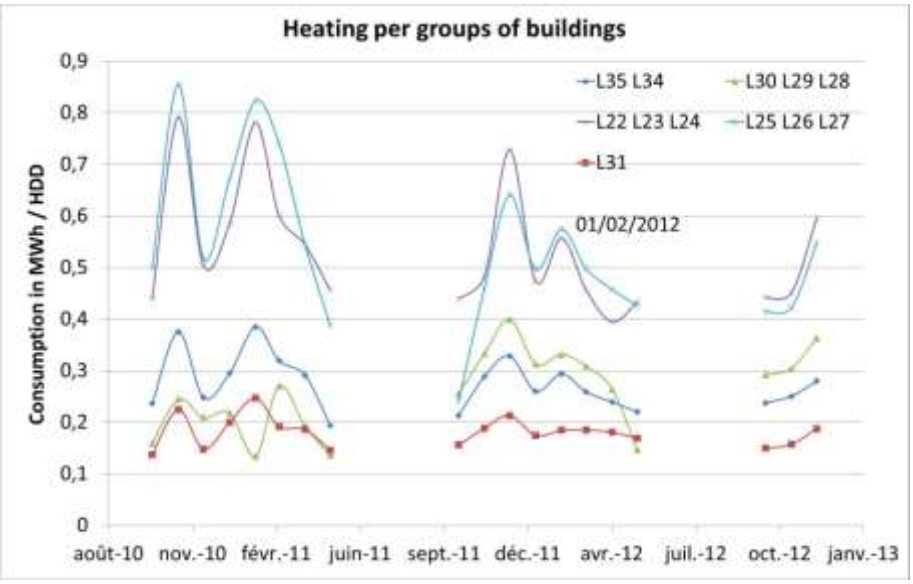
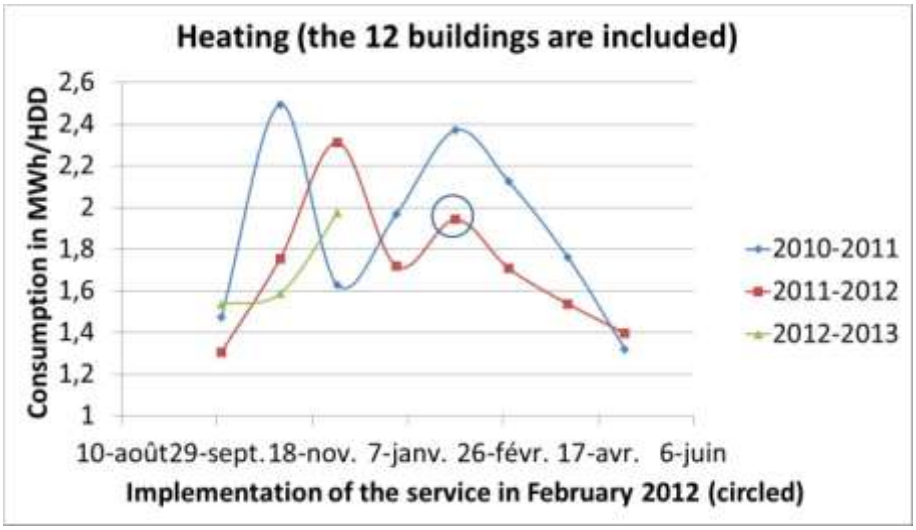


Figure 4-15: Consumption (HDD corrected values) for the whole buildings, from October 2010 to December 2012



4.1.3 Results of tenant survey analysis

In Angers two tenant surveys (more related to qualitative survey approaches) have been carried out – the baseline survey which was part of the energy coach visits in March 2012 and the final survey in December 2012 at the end of the reporting period. In total, 43 tenants participated in at least one stage of the survey - 40 tenants in the baseline survey and 10 tenants in the final survey. Thereof seven tenants were respondents in the baseline as well as in the final survey. In the baseline survey sample were 9 (later) EAS users and 29 non-users. In the final survey 2 users and 8 non-users participated. Even though the sample sizes are too small in order to carry out before-after-comparisons resp. user/non-user-comparisons, the surveys allow several analyses of interest for the eSESH project.

Table 4-6: Number of total dwellings and of tenants in the surveys (absolute number of respondents)

Angers	Number of dwellings	Baseline survey	Final survey	Thereof with both surveys
Brissac	55	4		
Eventard A, B	142			
Haut Chêne	70	20	5	5
La Roseraie	607			
Millot	28			
Mongazon A - D	110	16	2	2
			3[7]	
Total	1012	40	10	7

The baseline survey as well as the final survey contained socio-demographic characteristics as sex, age, size of the household. The first survey mainly focussed on the equipment with electrical appliances, timer functionalities of appliances, the development of the tenant's energy consumption and actions respondents already undertook to reduce their energy consumption. The final survey emphasised the energy consumption behaviour of the tenants, their attitudes towards environmental issues and their information level concerning energy consumption.

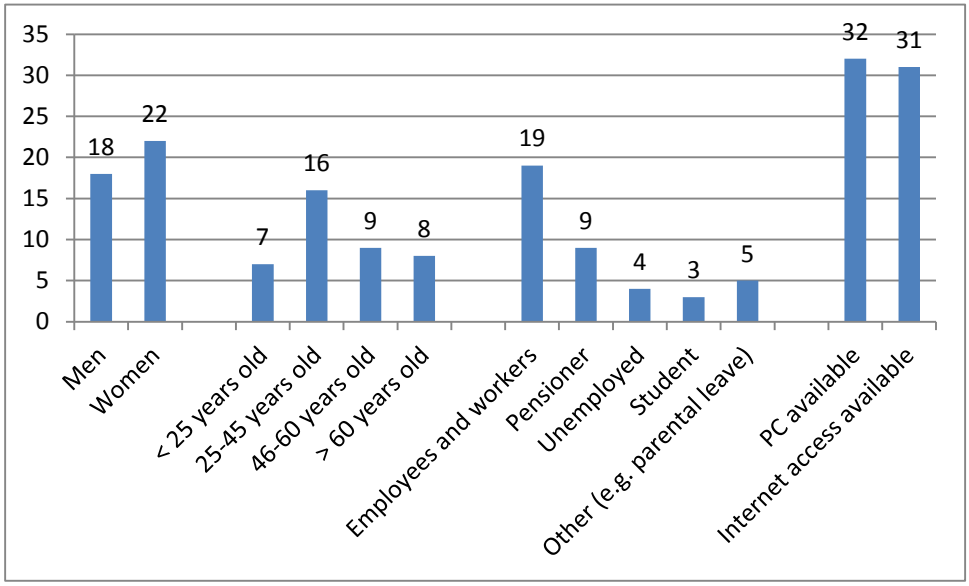
Due to the data cleansing procedure (heating and water) and missing electricity measurements energy consumption data for tenants who participated in the surveys were not available. Therefore a combined analysis with consumption data could not be realised. The data situation in Angers only allows a descriptive analysis of the baseline and the final survey.

[7] For three respondents of the final survey the pilot information was missing.

Results of the baseline survey

Among the sample of the baseline survey were 18 men (45%) and 22 women (55%). Most of them were 45 years and younger. Nine respondents were pensioners.

Figure 4-16: Socio-demographic characteristics of the respondents of the baseline survey (total number of persons)



Most of the respondents have a personal computer and an access to the internet. Thereof most of them (87%) are very/rather often online. Four of the nine tenants who don't have an internet access are 60 years old or older.

Energy saving attitudes and interest in the EAS tenant portal

14 respondents assessed their current energy consumption as rather high or high. For the future 19 respondents anticipate an increased consumption for electricity and for water. 21 respondents have that assumption also regarding gas. As a consequence, 36 of the total sample of 40 respondents (90%) were very interested in a tenant portal which shall help them to save energy.

Of importance for the tenants were their own energy consumption influenced by the household equipment and the objective to consume less electricity and to reduce CO_2 emissions. In order to see the impact of behaviour changes they were also interested in historical comparisons with previous consumption periods. In addition to that a lot of respondents wanted to be able to manage the expenses and to estimate the costs.

Nearly all tenants (95%) keep their invoices of energy costs. 10 respondents reported to study their invoices more than once. The interest in bills is influenced by several reasons – e.g. to compare with previous bills (n=23) or to control the change of tariffs (n=10).

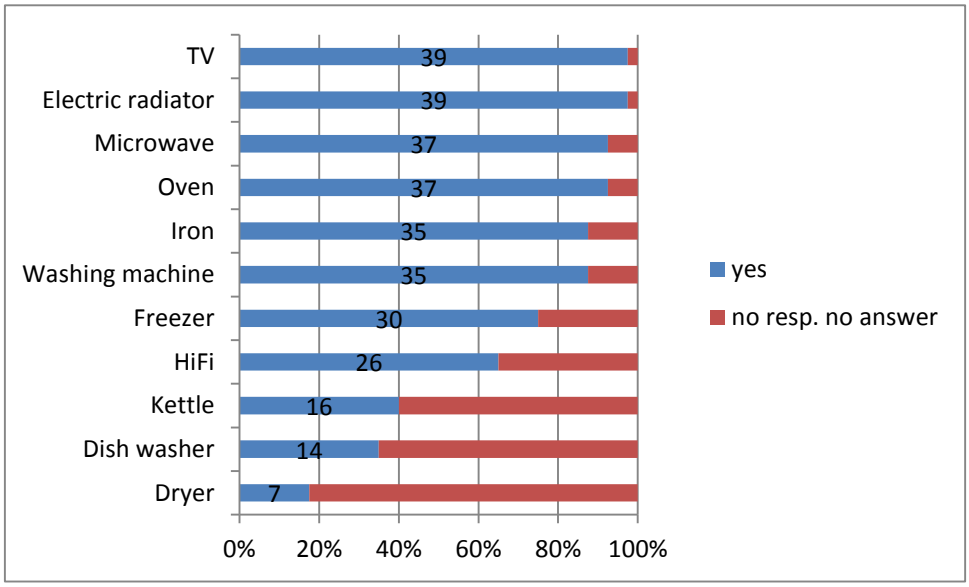
Table 4-7: Primary interest in the EAS tenant portal

	Absolute number of respondents	Percentage
To see the consumption which is influenced by the equipment	24	60.0
To consume less electricity and to reduce less CO_2	23	57.5
To see the change in energy consumption	22	55.0
To analyse the impact of behaviour on consumption	16	40.0
To manage expenses and to estimate the costs	15	37.5
To make comparisons to average consumption	10	25.0
Other	1	2.5

Equipment with electrical appliances

As the following figure shows all tenants are equipped with electric radiators and TVs. In addition to that most of the respondents have microwaves, ovens, washing machines, irons and freezers.

Figure 4-17: Equipment with electrical appliances



More than a half of the baseline respondents (n=23; 57%) reported that they know the energy efficiency label of their appliances.

21 respondents (52%) were strongly influenced by the energy class when purchasing new appliances. These 21 tenants have been furthermore asked what the most important aspect of a good energy efficiency label is. For most of them (n=19) the achievable savings are of importance followed by the protection of the environment (n=5)[8].

The washing machines of 19 respondents (54%) have a programmable timer function which is used by 14 respondents. The same applies in 5 cases for dishwashers and in one case for a dryer.

[8] Multiple answers were possible

25 respondents already in the baseline survey reported on energy-conscious consumption behaviour by choosing single actions shown in the following table.

Table 4-8: Actions to save energy

Angers	Number absolute	Number in % of cases
Use appliances in off peak time	7	28.0
Switch off the lights	6	24.0
Switch off appliances instead of stand-by	5	20.0
Using energy saving bulbs	4	16.0
Turn off water while washing during a shower	3	12.0
Change radiator, oil stove, no electric heaters	3	12.0
I don't heat, I lower my radiator	2	8.0
Willingness to buy a dishwasher	2	8.0
Shower instead of a bath	2	8.0
Shorter showers, I turn off the tap	2	8.0
Turn off the heating when windows are open	1	4.0
Bottle of water in the toilet	1	4.0

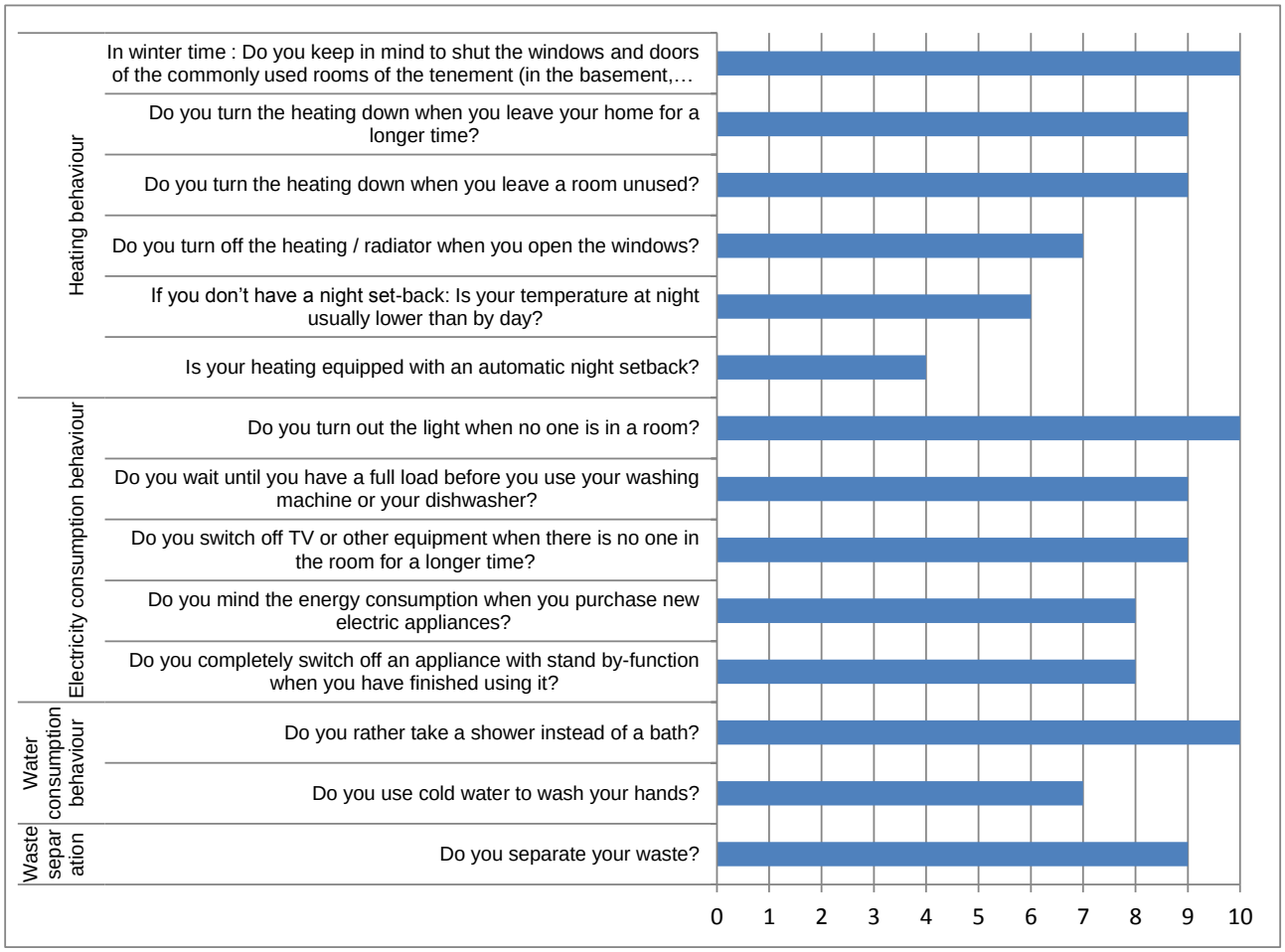
33 tenants prefer optimal indoor temperatures of max. 20°C. Only 4 respondents reported on higher than 21°C room temperatures.

Results of the final tenant survey

Only ten persons participated in the final tenant survey – five men, three women and in two cases men and women answered the questionnaire together. One tenant is between 15 and 24 years old, two tenants between 25 and 39, two tenants between 40 and 54 and four tenants 55 years or more (and one missing). The household size is rather small: seven tenants live in a single- or two-person household, three tenants live in a three- or four-person-household. All tenants were born in France. The education level is rather low, 4 tenants do not have a school-leaving qualification, four tenants owns a primary modern school-leaving qualification and two tenants a secondary modern school-leaving qualification. Half of the tenants have a monthly household net income under 1,500 Euro. 80% have a permanent access to internet. Two persons were EAS users, 8 respondents were non-users, so that a user/non-user comparison is not useful.

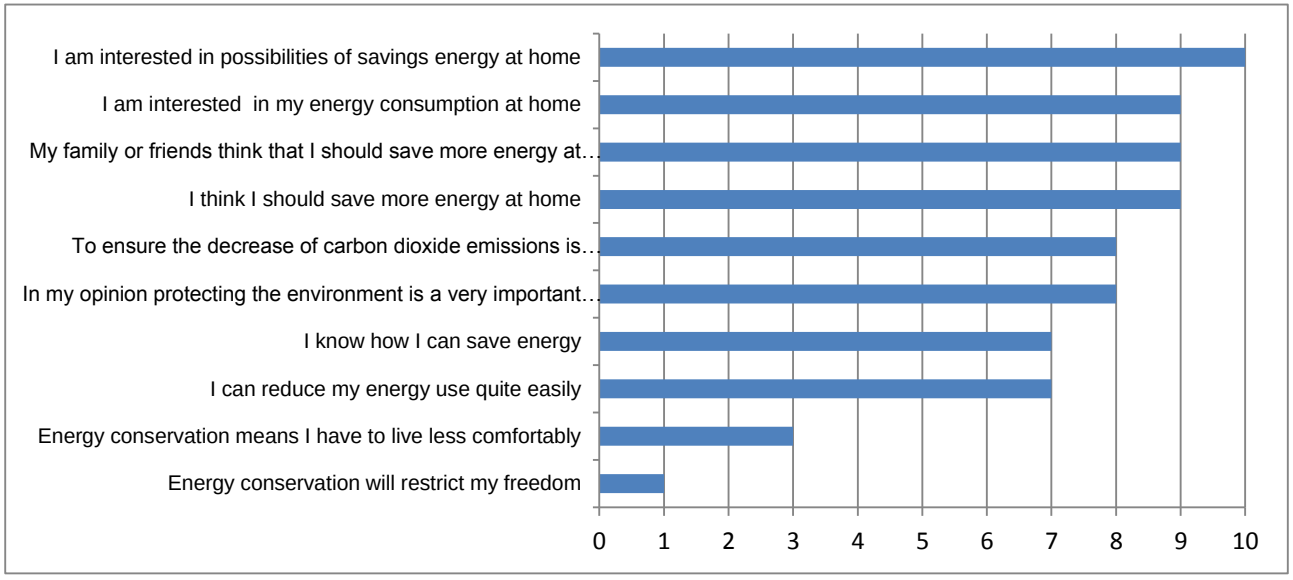
The above stated already energy-conscious behaviour of the baseline respondents can also be stated for the pilot tenants in the final survey sample. As the following figure shows the majority of respondents consume very consciously heat energy, electricity and water.

Figure 4-18: Reported energy consumption behaviour



That finding is underlined by the reported attitudes towards environmental issues. E.g. all respondents (users and non-users) are interested in the possibilities of saving energy at home.

Figure 4-19: **Attitudes towards environmental issues ("I strongly agree" and "I rather agree")**



Corresponding to that, the information level of the tenants is predominantly good:

- 9 out of 10 respondents felt very/fairly well informed about their energy savings.
- 8 out of 10 respondents felt very/fairly well informed about their energy consumption.
- 7 out of 10 respondents felt fairly well informed about the possibilities to protect the environment.
- User as well as non-users are interested in further energy saving tips (n=7).

4.2 Catalonia

4.2.1 Background information

The eSESH services are aiming at overall energy savings and fixed-time demand reduction with the consequent benefit of lowering contracted power in the future. The services offered in Catalonia are based on monitoring data at three levels of detail, in order to find the optimal configuration that, in view of the obtained results, could permit the extension of the services in larger scale. The foreseen services are based on monitoring data at three levels of detail, each of them requiring different ICT equipment investment cost (from low to high).

Figure 4-20: Screen shots of EAS tenant portal in Catalonia

The EAS service of Catalonia is created on energy data collection in above described three levels of detail and provides tenants with visualisation of the energy consumption's evolution, access to historic consumption in different time scales, benchmarking, setting of energy consumption objective and energy saving tips. Personalised energy saving tips are generated automatically according to the consumption. Tips not only depend on consumption resulting in generic advice (e.g. lower temperature of thermostats) but take into account the environmental influences and suggest appropriate actions according to the tenant specific consumption pattern.

The EMS service focuses on the maintenance of the centralised solar system for DHW. Automatic maintenance warnings are created from the monitoring system and sent to maintenance staff in case of failure of the solar system.

In total, 77 dwellings in two buildings were involved in the pilot, but 6 dwellings stayed unoccupied during the eSESH project.

Table 4-9: Overview of the number of buildings and dwellings involved in the Catalonia pilot

Site	Pilot site name	Number of buildings involved	Number of dwellings involved
Catalonia	Clota	2	53
	Cordoba I		18
	Cordoba II		4
	Cordoba III		2

The tenant recruitment in Catalonia has been carried out in several phases. With signing the rent contract tenants permit their consumption readings. A kick-off meeting and several training sessions followed when introducing the project and the tenant portal. In addition to that tenants receive monthly reports which show their consumption figures, main incidences and tips to solve them.

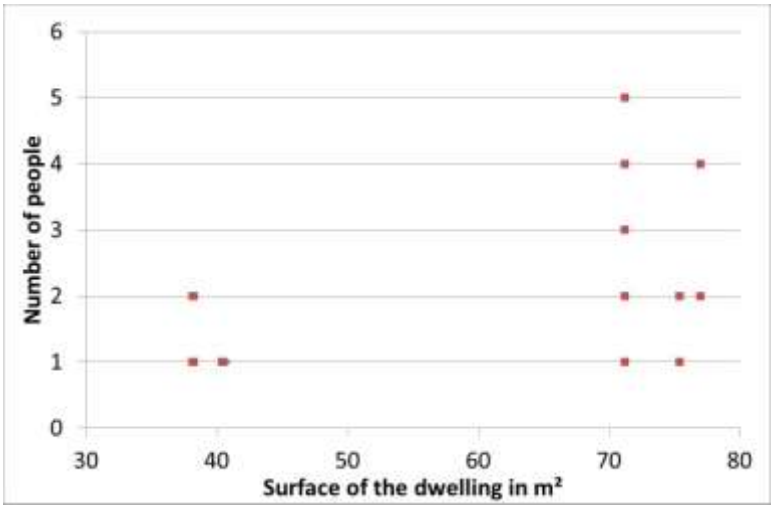
The eSESH EAS service started operation in January 2012. Pilot tenants who logged in the web portal have been counted as users. Those who didn't log in were counted as non-users. In total, 54 tenants (76% of the total number of occupied pilot dwellings) are EAS users.

4.2.2 Results of consumption data analysis

In Catalonia the consumption measurements were related to domestic electricity used for household appliances and lighting and to gas used for different usages (heating, domestic hot water and cooking). 77 dwellings have been equipped with the eSESH service.

The number of people per dwelling and the size of the dwellings are important elements considered in the analysis. The graph below related to dwellings included in the analysis shows, that single- and two-person-households live in smaller as well as in larger dwellings, whereat bigger households live in larger dwellings as expected.

Figure 4-21: Number of people living the in the pilot households related to dwelling size



Before analysing the data it was necessary to cleanse it in order to take into account the changes of tenancy which occurred during the project, as well as some incoherencies or periods of absence of the tenants. In these cases, these dwellings were excluded from the data analysis. The cleansing step for electricity data led to a number of 44 dwellings which were included in the electricity data analysis. 38 dwellings could be analysed regarding their gas consumption. The dataset that is analysed represents nearly 60% of the total number of dwellings.

For calculating the savings a pre-post comparison has been used. The pre-post comparison is based on the analysis of the evolution of the consumption figures before and after the implementation of the service. In view of the eSESH service start in January 2012, the

consumption during the baseline period (Jan 2011 – Dec 2011) has been compared to the consumption of the reporting period (Jan 2012 – Dec 2012). The lengths of the baseline and the reporting periods, 12 months, enable to have a good consistency of the data.

Table 4-10: Description of the cleansing step

Site	Data	Number of dwellings	
		before cleansing	after cleansing
Catalonia	Electricity	77 (occupied 71)	44
	Gas	77 (occupied 71)	38

The following data analysis sections show the impact of the cleansing step as well as the results in terms of savings after the implementation of the service.

Global results of electricity and gas analysis (EAS)

The global calculation of savings following a pre-post comparison led to the results shown in the following table. Therefore total savings of about 32% gas and nearly 6% electricity have been observed which equates to savings of nearly 60 thousands kWh gas per year and more than 4 thousands kWh electricity. These savings are in particular very important for gas.

Compared to the expected savings in total of 10% up to 20% (see D7.1, related to the above described three different levels of detail) these results are a full success.

Table 4-11: Overview of global results in Catalonia (EAS)

Key data		
	Electricity	Natural Gas
Number of dwellings	44	38
Surface area (average)	50	51
Number of people (average)	1,66	1,74
Global Results for the dataset of dwellings		
	Electricity	Natural Gas
Savings (%) - eeMeasure (weighted)	5,80%	32,30%
Saving (kWh/yr or m3/yr) - eeMeasure	4 378	59 814
Carbon Dioxid Reduction in kgCO2/yr - eeMeasure	2 797	14 176
Financial Saving (€/yr) - eeMeasure	915	3 230
Consumption Before Intervention (kWh/yr - average)	75 523	184 662
Results (per dwelling, per people or per m²)		
	Electricity	Natural Gas
Consumption Unit	*(kWh/m².year)*	*(kWh/m².year)*
Consumption - Before intervention	35	95
Consumption - After intervention	33	63
Consumption Unit	*(kWh/dwelling.year)*	*(kWh/dwelling.year)*
Consumption - Before intervention	1 716	4 860
Consumption - In the same country*	2 307	-
Savings	100	1 574
Carbon Dioxid Reduction in kgCO2/dwelling.yr	64	373
Financial Saving (€/dwelling.yr)	21	85
** See references*		

Electricity

For electricity, it is important to compare the levels of annual electricity consumption per m². The graph below shows that the consumption of the dwelling is not correlated to its size which is due to the imponderables of any dwellings (TV, household appliances…).

Figure 4-22: Annual Electricity Consumption (in kWh/m²) related to the surface of the dwelling in m², 2011

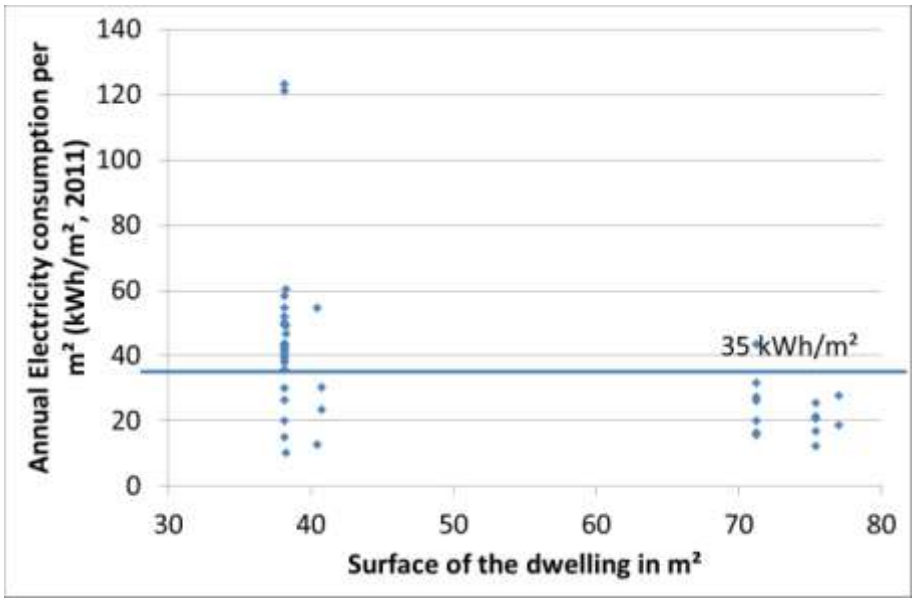
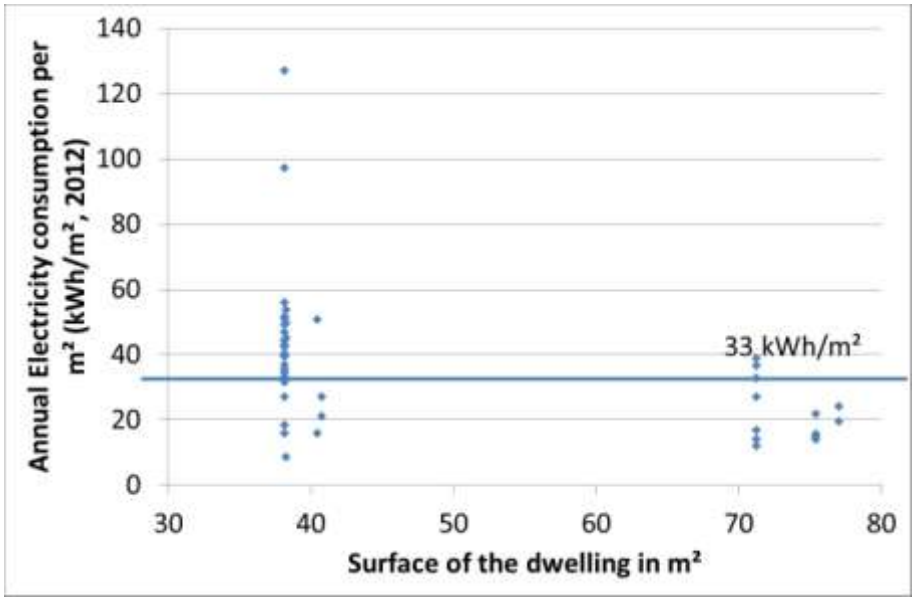


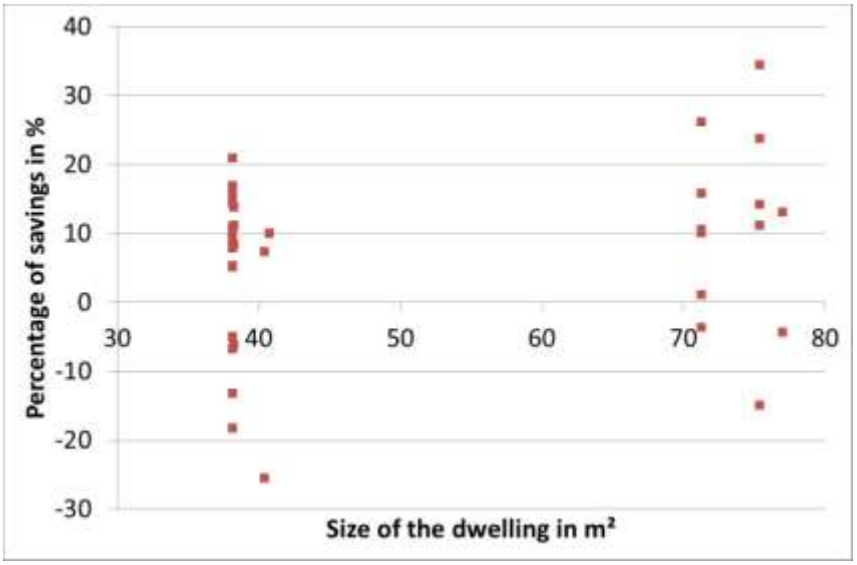
Figure 4-23: Annual Electricity Consumption (in kWh/m²) related to the surface of the dwelling in m², 2012



As to be seen in the above figure, 2 dwellings have very high electricity consumptions. These two dwellings have an important impact on the 5.8% global savings. Indeed, without one of these two dwellings, which made a percentage of savings of 21%, the global saving is decreased to 1%. This analysis shows that the impact of the high consumers on the global results is very important and can influence the whole result. As a consequence, it could be very interesting to work specifically with these high consumers. A targeted action towards the high consumers would have a direct impact on the global results.

In the following it is of interest to study the relation between the percentage of savings and the size of the dwelling.

Figure 4-24: Percentage of savings (+values) related to the surface of the dwelling in m²



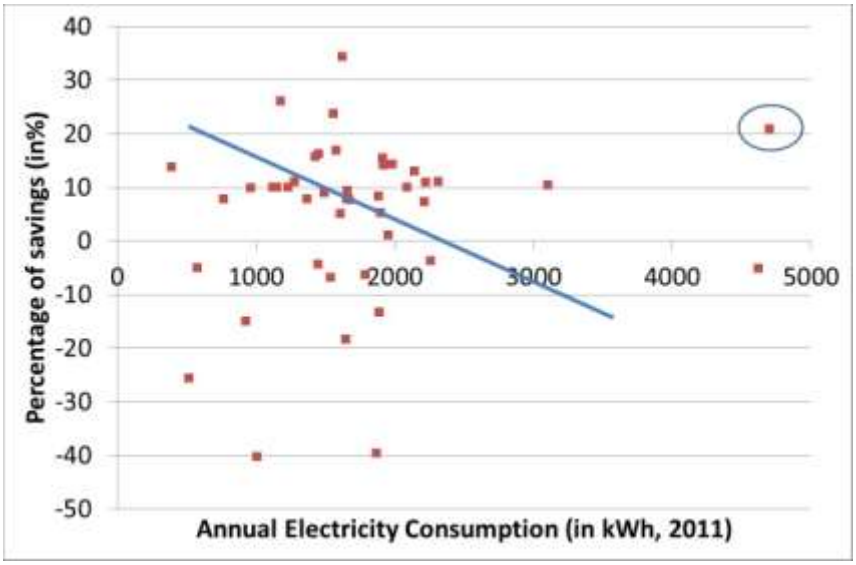
The graph above shows that a significant number of dwellings made savings. Indeed, 73% of the dwellings achieved savings whereas 27% of the dwellings have higher consumptions during the reporting period. Moreover, among the tenants who made savings, most of them made between 5% and 30% of savings. The 5% stage seems to be overcome easily by the tenants.

Besides, this graph shows that most of the large-sized dwellings made savings whereas it is not the case for the small dwellings. This conclusion will be discussed later on in the analysis.

To follow, the surface of the dwelling can be replaced by the annual electricity consumption of the baseline period. The figure below shows that there is a tendency of already low consumers to make more savings than high consumers (except for one case, circled on the graph, which was discussed before). This tendency is highlighted by the blue trend line.

Lastly, it is interesting to compare the level of consumption of these tenants with the national level of consumption. In Spain, the annual electricity consumption (used for appliances and lighting) equals 2307 kWh/dwelling. For the analysed set of dwellings in Catalonia an average consumption of 1716 kWh/dwelling has been calculated. Thus, the pilot tenants already consume less than the national average and as a consequence their possibilities are limited in terms of feasible savings. This conclusion is also highlighted by the first chart which shows that these dwellings have already electricity consumptions close to 50kWh/m² and year. This consumption of 50kWh/m² was the objective set by the Social Housing Company for these buildings. Thus, the feasible savings were limited.

Figure 4-25: Percentage of savings (+ values) related to annual electricity consumption in kWh



Gas

First, the level of annual gas consumption before implementation of the service is compared to this level after implementation of the service. From the two followings charts it can be observed a global decrease of the consumptions. Indeed, there is a tendency for gas consumptions to settle down under the mark of 150kWh/m².

Figure 4-26: Annual Gas Consumption (in kWh/m²) related to the surface of the dwelling in m², during the baseline period

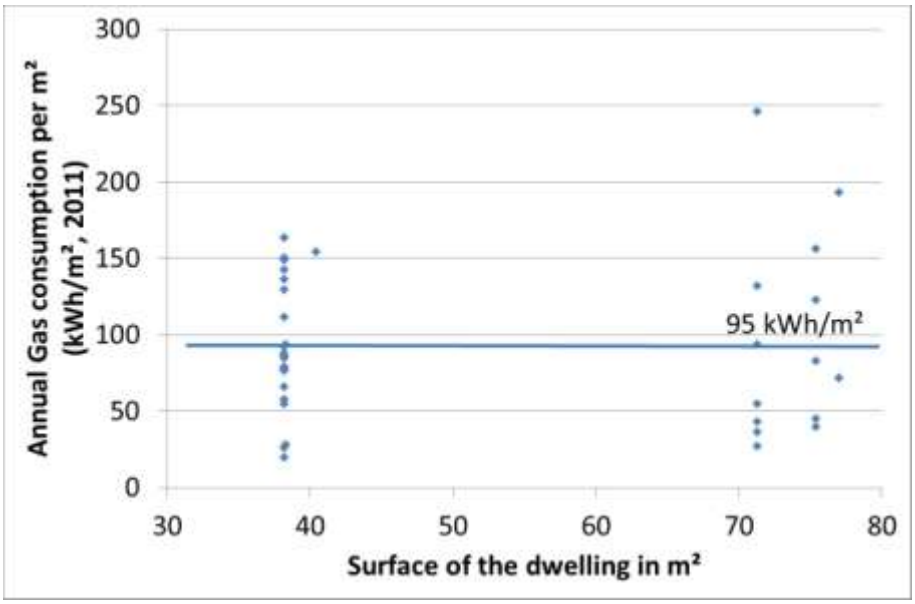
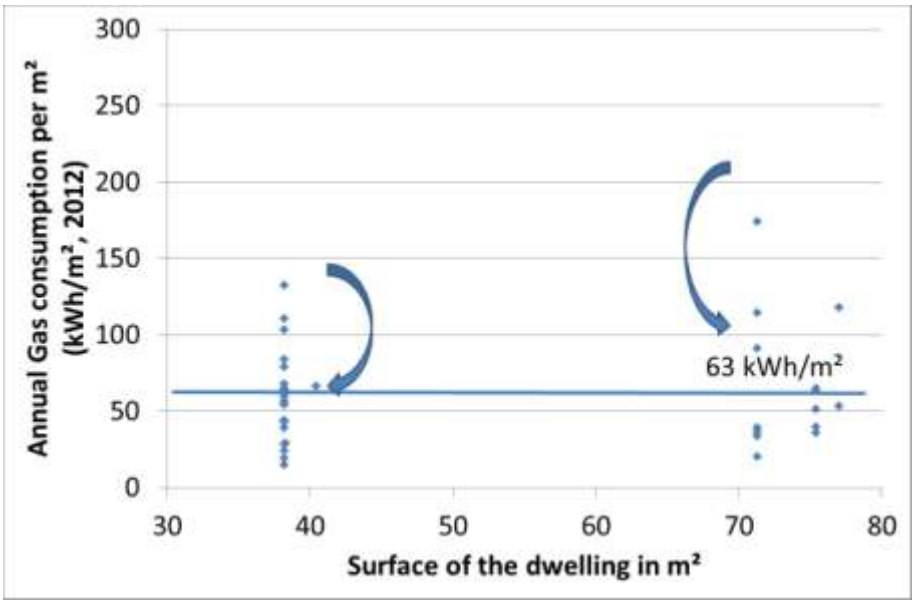
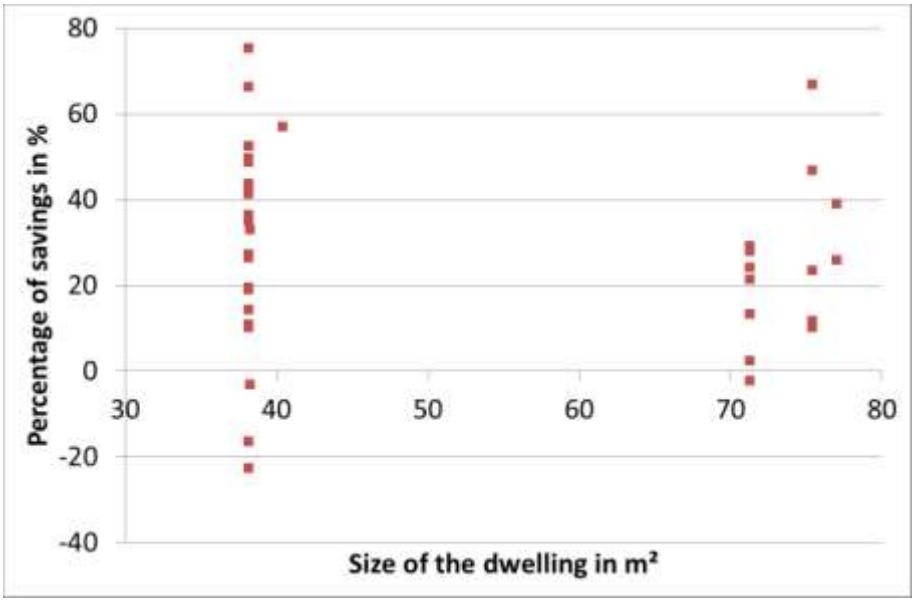


Figure 4-27: Annual Gas Consumption (in kWh/m²) related to the surface of the dwelling in m², during the reporting period



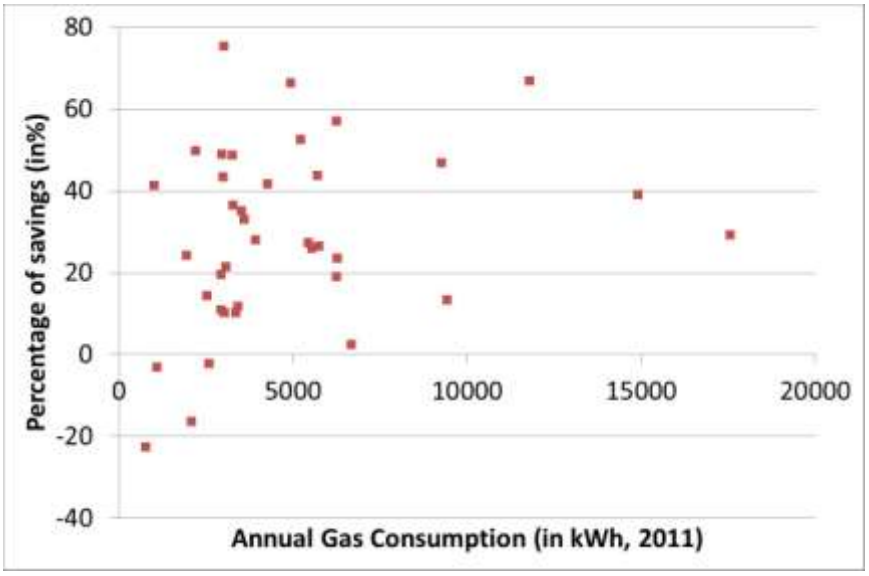
The chart below which represents the percentage of savings related to the surface of the dwelling, shows that 90% of the dwellings made savings. As for electricity, the limit of 5% of savings seems to be overcome easily by the tenants.

Figure 4-28: Percentage of savings (+ values) related to the surface of the dwelling in m²



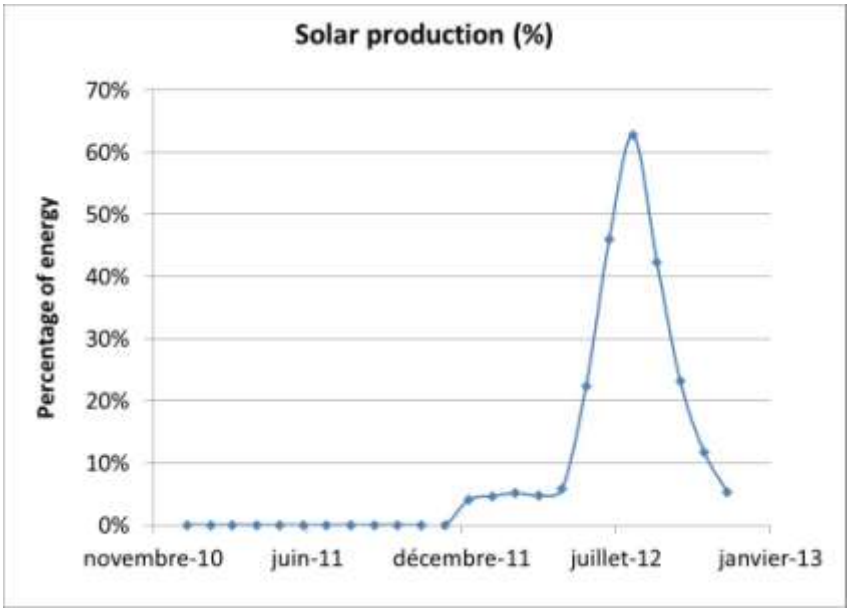
It is now interesting to study the percentage of savings related to the annual gas consumption. The graph below shows in that context that the 4 dwellings without achieved savings belong to low consumers.

Figure 4-29: Percentage of savings (+ values) related to the annual gas consumption in kWh



In contrast to electricity, in the case of gas the level of consumption during the baseline period was high. Indeed, the objective of consumption for heating for this building was set to 43kWh/m²*a (objective set within the frame of the Concerto initiative Policity), but during the baseline period it became apparent that the average annual consumption was equal to 95 kWh/m² (for heating, but also domestic hot water and cooking). Thus, the feasible savings for gas were higher than for electricity. This can explain the high percentage of savings for gas. Moreover, the high percentage of savings for gas is related to the setting up of a solar thermal system which started operation in January 2012.

Figure 4-30: Solar Production for Domestic Hot Water, for one dwelling which has been instrumented



Comparison between users and non-users

In Catalonia most of the tenants (n=54) use the EAS more or less regularly. That's why a user/non-user-comparison in the classical meaning is not very meaningful. In addition to the EAS use some tenants got further advice in a personal meeting with an energy coach. These tenants in the following analysis called as 'user'. Tenants without energy coach visit are named as 'non-users'. The analysis of both tenant groups led to the following distribution.

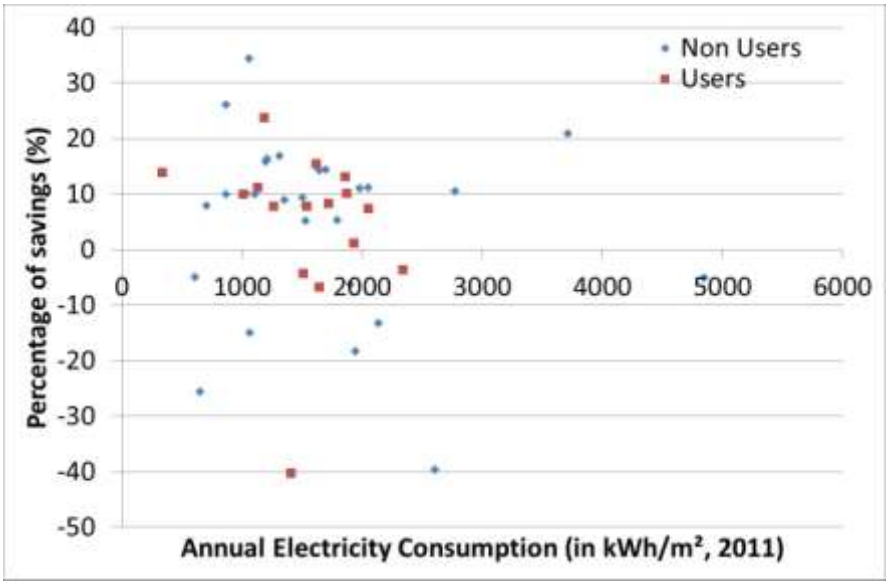
Table 4-12: Distribution of users (tenants visited by an energy coach) and non-users (tenants without contact to an energy coach) in the consumption dataset with savings calculation

Comparison between users and non-users					
		Electricity		Natural Gas	
Total of dwellings	Users	16	36%	13	34%
	Non Users	28	64%	25	66%
	Total	44	100%	38	100%
Surface per dwelling	Users	54,02		54,94	
	Non Users	47,14		49,33	
People per dwelling	Users	2,13		2,15	
	Non Users	1,39		1,52	
Average Annual Consumption 2011 (baseline period)	*Unit*	*kWh/(dw.year) in 2011*		*kWh/(dw.year) in 2011*	
	Users	1613		5811	
	Non Users	1667		3076	
% of dwellings which made savings	Users	75%		100%	
	Non Users	71%		84%	
	Total	73%		89%	
Savings (%)	Users	5,30%		37,70%	
	Non Users	6,10%		28,70%	

Electricity

As shown in the table above, 73% of the tenants made savings, users and non-users included. Focussing on the users of the service (as defined above), 75% of them achieved a decrease of electricity consumption – even if the percentage of savings is slightly lower than that of non-users. The graphs below show that the service has a real impact on the tenants.

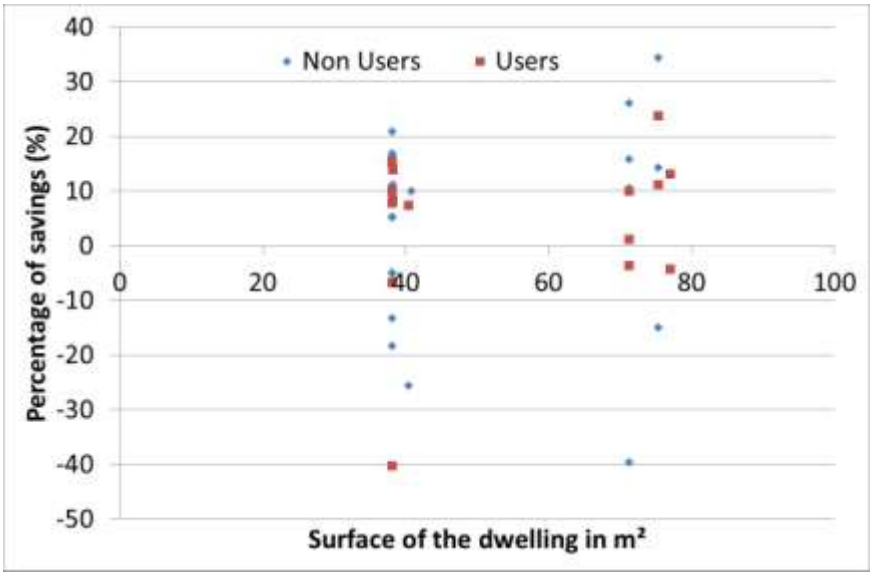
Figure 4-31: Percentage of savings (+ values) related to annual consumption in kWh/m² in 2011, for users and non-users



Moreover, it appears that the dwellings in which more than one people live are more involved in the project. As the above table showed, the number 'persons per dwelling' is with an average value of 2.1 higher for users than for non-users (1.4). The tenants who live alone seem to feel less affected by the objectives of the project. It can be assumed, that this result is related to the way of living of these tenants who might spend less time at home than others. For multi-person households, the eSESH service enables to have a global overview of the singular consumption behaviour which can be used, for example, by parents to survey the behaviours of the children.

Considering the fact that tenants who share their dwelling appear to be more interested in the service, it could be interesting to find proper ways to address the tenants who live alone.

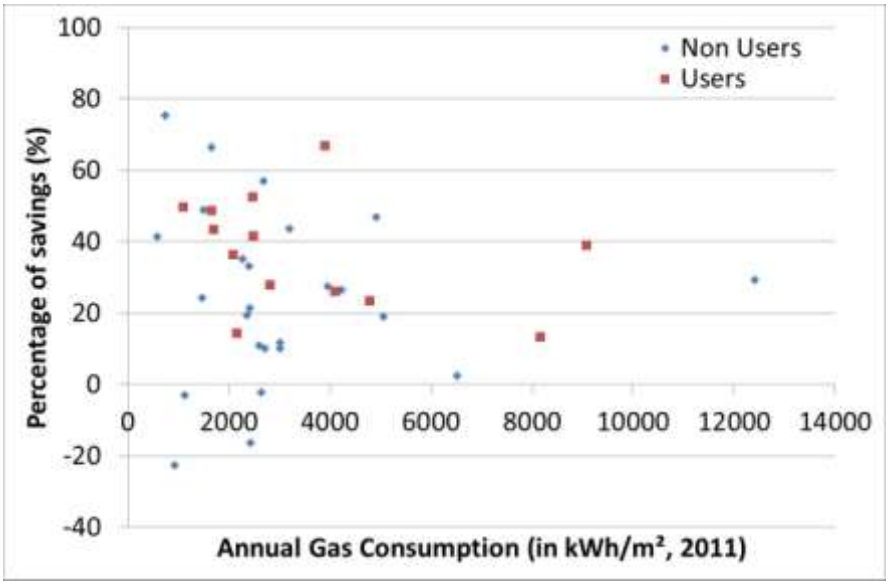
Figure 4-32: Percentage of savings (+ values) related to surface of the dwelling, for users and non-users



Gas

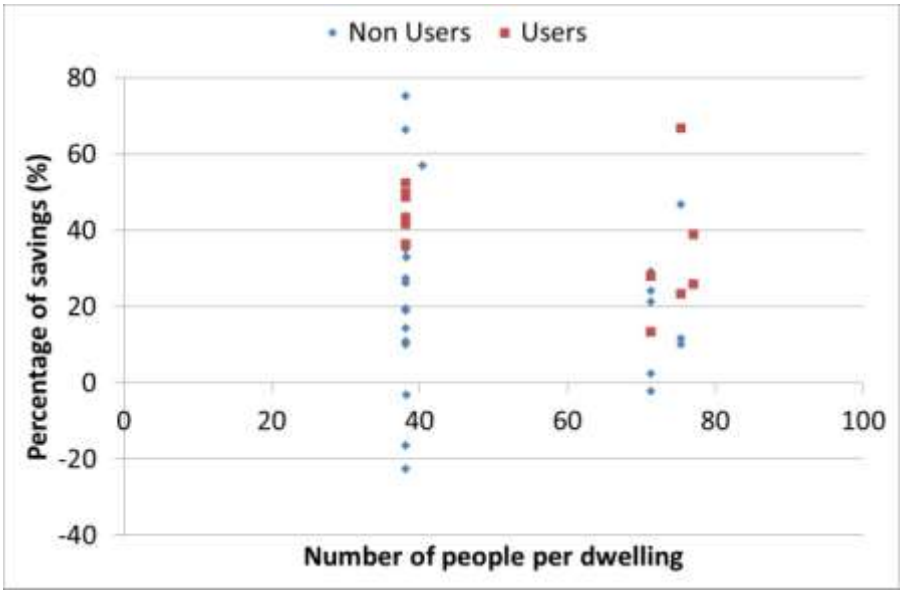
For gas, the users visited by an energy coach achieved higher savings than the non-users (38% compared to 29%). This result might be related to the average consumption of both groups before implementation of the service (see again table above). While similar levels of electricity consumption for both users and non-users could be observed, in the case of gas users had much higher baseline gas consumption than the non-users.

Figure 4-33: Percentage of savings (+ values) related to annual consumption in kWh/m² in 2011, for users and non-users



As already regarding electricity consumption can be considered that tenants who live alone seem to be less engaged in the project.

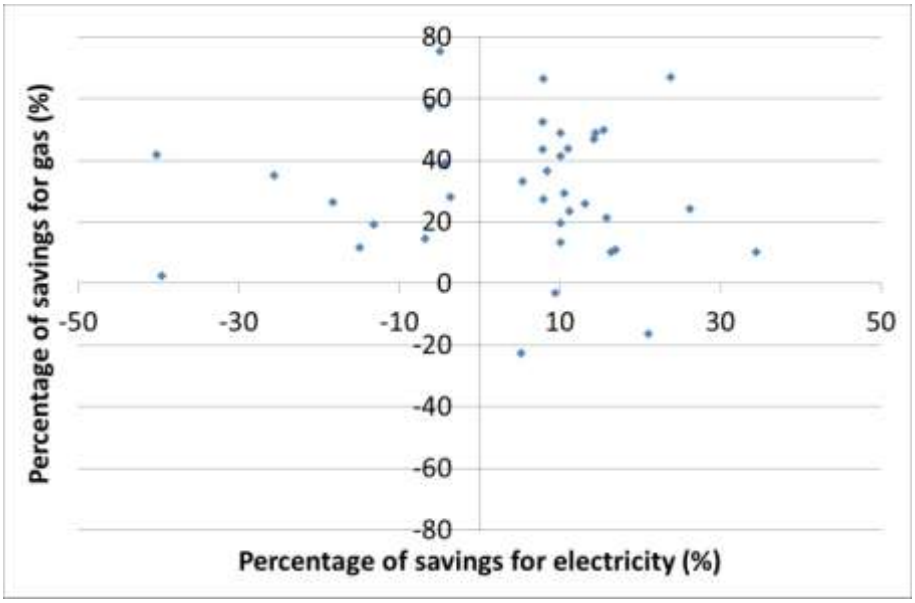
Figure 4-34: Percentage of savings (in %) related to the surface of the dwelling, for users and non-users



Cross analysis

To conclude, a cross analysis was done to compare the electricity and the gas savings. That analysis shows that most of the dwellings made electricity and gas savings. An important conclusion is also that all the tenants made savings on at least one of the two parameters.

Figure 4-35: Cross Analysis between the percentage of savings (+ values) for Gas and Electricity



Global results of EMS

As said in the 'background information' section, the EMS service focuses on the maintenance of the centralised solar system for domestic hot water. Automatic maintenance warnings are created from the monitoring system and sent to maintenance staff in case of failure of the solar system.

Thus, monitoring of the central solar system for DHW of the Cordoba building and the associated EMS have helped to detect failure in the system operation which otherwise would have remained unnoticed for long period. Interventions and preventive work were carried out thanks to the eSESH service during the project.

4.2.3 Results of tenant survey analysis

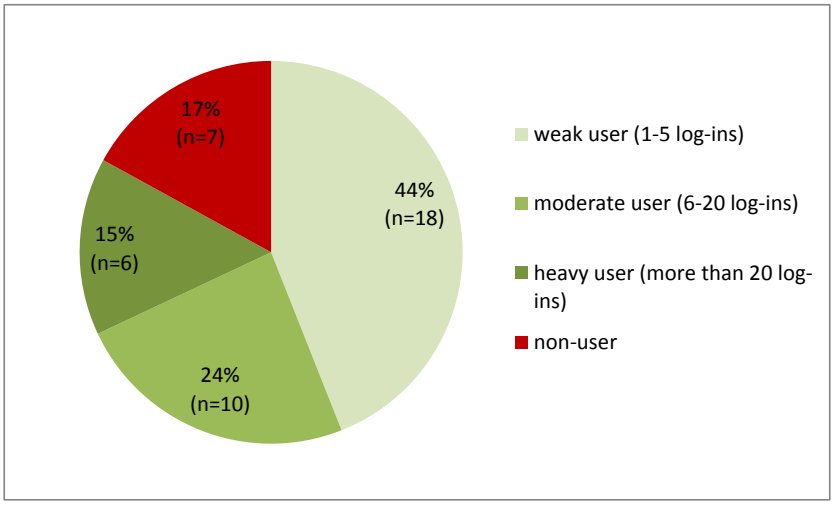
The Catalonia pilot site carried out two tenant surveys – the first one in December 2011 at the end of the baseline period, the second one in December 2012 at the end of the reporting period. In total, 41 of the 77 pilot tenants (53 %) participated in at least one stage of the survey. 15 tenants (19 %) participated in both stages of the survey. Their responses could be included in the longitudinal study resp. before-after-comparison.

Both surveys mainly focussed on heating and ventilation behaviour, attitudes regarding energy saving behaviour, satisfaction with the provided EAS tenant portal and socio-demographic standards.

EAS use and socio-demographic characteristics

Among the 41 respondents in the sample are 34 users of the tenant portal (83 %) who use the EAS more or less regularly. The usage of the tenant portal ranges from 1 up to 42 visits in the reporting period which covers the complete year 2012. On average the survey respondents logged in for 10 times. Seven respondents (17 %) did not use the EAS during the project duration.

Figure 4-36: Number of users and non-users of the EAS in the tenant survey sample of Catalonia (n=41)



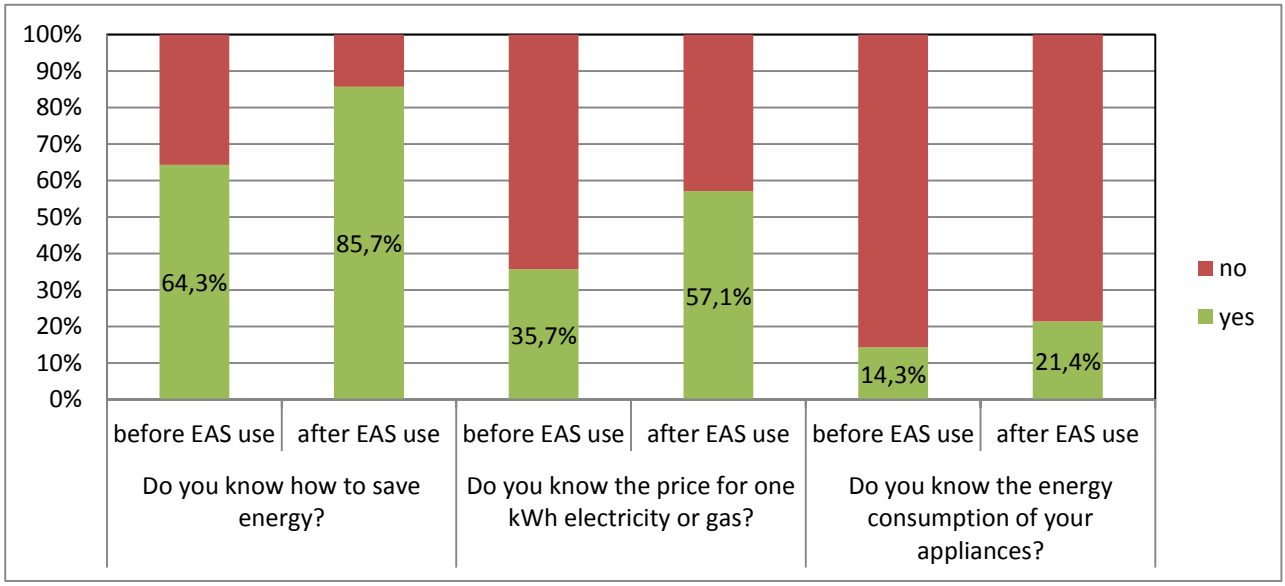
Among the 15 respondents who participated in both stages of the tenant survey are 14 EAS users, 6 men and 8 women between 25 and 39 years old. Most of them live in single- or two-person households (each n=5). Two households receive aid money. More than three quarters of these respondents have a household net income below 1.500 €. All of them have internet access – 69 % PCs or laptops and 31 % smart phones.

Before-after-comparison of energy knowledge and energy consumption behaviour

In view of the small sample size of the longitudinal study the following results have a limited significance only. Nevertheless, they can give some indications about the impacts of EAS use.

As the following table shows, the knowledge about energy saving issues increased significantly after using the Energy Awareness Service. Now more tenants reported on consolidated knowledge about how to save energy – 86 % compared to 64 % at the beginning of the eSESH project. Furthermore they are more often aware of the energy prices for electricity and gas. A slight increase could be also observed regarding the knowledge about the energy consumption of the household's appliances.

Figure 4-37: Knowledge about energy saving issues before and after the EAS use (n=14)



50 % of the EAS users who participated in both survey stages reported that they changed their energy consumption behaviour as a result of the EAS use.

When looking on those aspects which were topics in the tenant survey these changes are not reproducible (see following table). This could be caused by the fact that the majority of these EAS users already act very energy conscious regarding the mentioned behaviour pattern in the surveys. But the possibilities of saving energy at home are various, so it is very likely that people choose further measures for energy reduction which were not asked for in the survey. There is some evidence in table 4-14 where is shown that people with self-reported behavioural changes have more measured electricity savings compared to that group with no reports on changes in energy consumption behaviour. Electricity consumption behaviour has not been focussed in the questionnaires at the Catalonia pilot site.

Table 4-13: Pre-post-comparisons of aspects of energy consumption behaviour (n=14)

Aspects	value labels	Before EAS use	After EAS use
Do you turn off the heating when you open the windows?	yes	84,6%	76,9%
	rather yes	15,4%	15,4%
	rather no		7,7%
Do you turn the heating down when you leave your home?	yes	84,6%	85,7%
	rather yes	7,7%	7,1%
	rather no	7,7%	7,1%
Do you turn down the heating at night?	yes	76,9%	64,3%
	rather no	15,4%	35,7%
	no	7,7%	
Which room temperature does your home have in winter?	< 20°C	23,1%	28,6%
	20 °C	46,2%	42,9%
	21-23 °C	15,4%	7,1%
	> 23 °C	15,4%	21,4%
Do you wash the dishes with warm water?	yes	69,2%	28,6%
	rather yes	15,4%	57,1%
	rather no	7,7%	7,1%
	no	7,7%	7,1%
Do you wait until you have a full load before you use your washing machine?	yes	84,6%	64,3%
	rather yes	7,7%	21,4%
	rather no	7,7%	14,3%

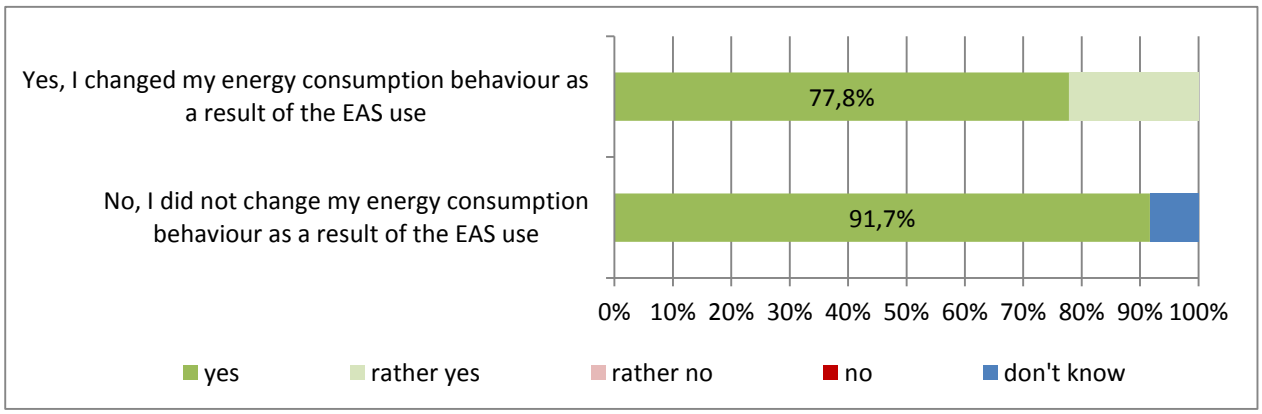
As the below table further shows all EAS users with self-reported changed energy consumption behaviour have achieved significant average savings of 17 % electricity and 31 % heating. In contrast to that, in the comparison group there are 12 % of users who have increased electricity and heating consumption. In addition to that, the measured minimum savings of that first mentioned group are higher compared to the other group of users who did not change their energy consumption behaviour motivated by the EAS use.

Table 4-14: Measured savings of EAS users with and without reported behavioural changes (n=34)

Reported changes	Energy type	Minimum saving	Maximum saving	Average saving
Yes, I changed my energy consumption behaviour as a result of the EAS use (42 %)	electricity	10%	26%	17%
	gas	20%	67%	31%
	No one of that group had an increased consumption.			
No, I did not change my energy consumption behaviour as a result of the EAS use (58 %)	electricity	8%	21%	11%
	gas	14%	66%	42%
	12% of that group had increased consumption.			

92 % of the respondents who currently did not change their energy consumption behaviour will try to do this in future. 78 % of those tenants who reported already on energy conscious behaviour want to intensify their efforts.

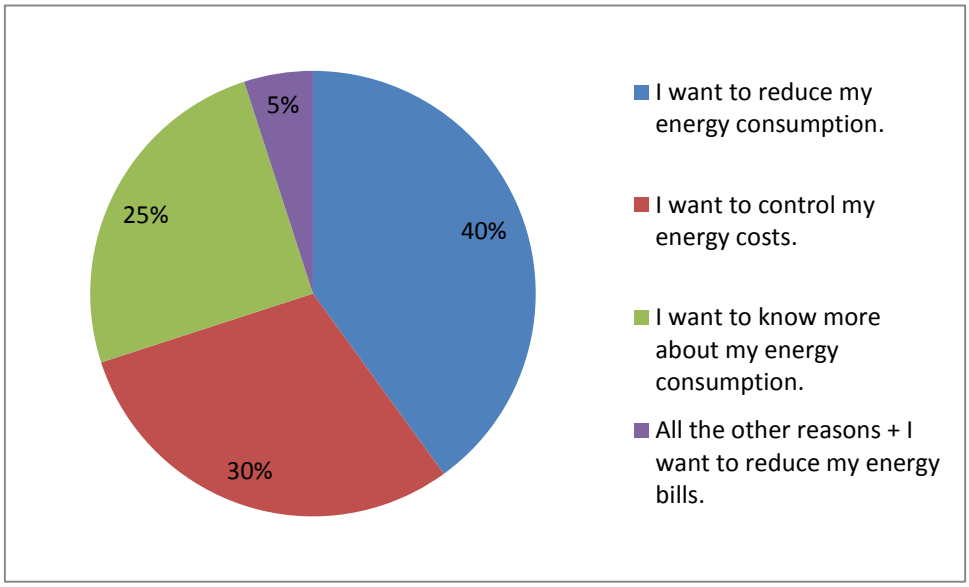
Figure 4-38: Increased effort to save energy in future (n=34)



Reasons for EAS use

Most of the EAS users are motivated by cost-related usage arguments – 40 % of the respondents wanted to reduce their energy consumption, further 30 % wanted to control their energy costs. To fill their knowledge gaps regarding energy consumption is a reason for 25 % of the EAS users.

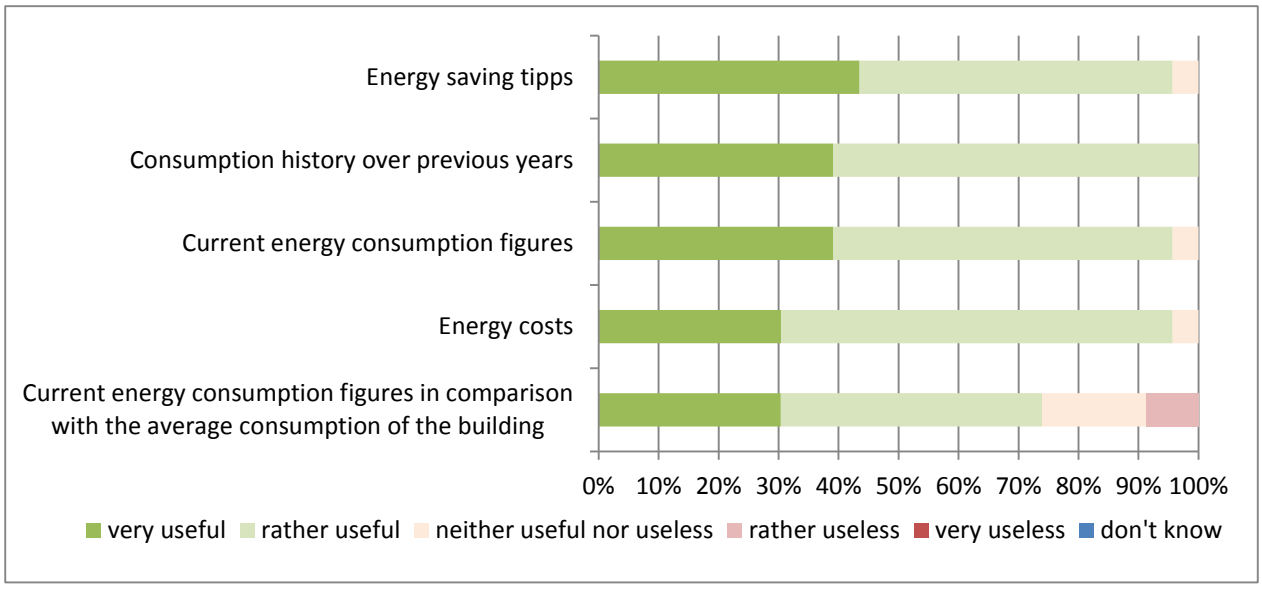
Figure 4-39: Reasons for EAS use (n=34)



Satisfaction with EAS

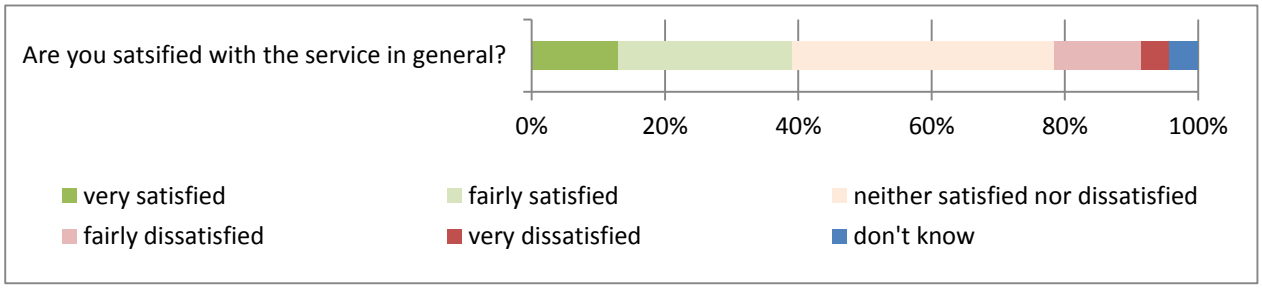
The majority of EAS users in Catalonia found the provided information in the web portal very or rather useful. The most accepted aspects were the given energy saving tips and the current consumption figures especially with historical reference values.

Figure 4-40: Assessment of the usefulness of several EAS information in Catalonia (n=34)



39 % of the respondents are satisfied with the provided service. An equivalent number of users have no opinion yet.

Figure 4-41: General satisfaction with the EAS in Catalonia (n=34)



4.3 Extremadura

4.3.1 Background information

The energy awareness service (EAS) in Extremadura consists of a web portal to check and to control the household electricity consumption on a fortnightly basis. It contains tips for saving energy in a personalised way which base on a separate study of the special characteristics of each property. In addition to that tenants receive annual reports by email and by postal mail summarising the electricity consumption of the household in the previous year.

Figure 4-42: Screen shot of the EAS web portal of Extremadura

The electricity data collection has been performed with a smart meter, data were sent with a 3G router.

The data of the office web portal contains:

- Set generic threshold to consumption values.
- Reading of consumption values (electricity).
- Visualisation of electricity load profiles for tenants (15 min, daily, monthly, yearly)
- Read status of measurement and communication equipment.
- Allow for comparison of consumption values with anonymous data of other tenants.
- Generate an annual report to be sent to the household on paper

In total 116 dwellings were involved in the pilot. These dwellings are distributed at the locations shown in the following table.

Table 4-15: Overview of the number of buildings and dwellings involved in the Extremadura pilot

Site	Pilot site name	Number of buildings involved	Number of dwellings involved
Extremadura	Oliva de la Frontera	41	28
	Badajoz		61
	Miajadas		17
	Pallares		10

First information regarding the offered EAS has been given by telephone. In case of interest the tenants received an information letter with access data. In addition to that the tenants have been invited to participate in a kick-off meeting and a further tenant meeting. Tenant trainings had the intention to exercise the tenants in the usage of the web portal and software as well as in the understanding of their consumption graphics.

The pilot site of Extremadura used the visit service provided by Google Analytics to collect the number of user visits and further information about how users use the web site. There is an individual accounting page for each dwelling which makes it possible to know the number of visits per each individual household. Another page with access for technical staff guarantees the correct work of the visit service and allows the analysis of use frequency and data quality.

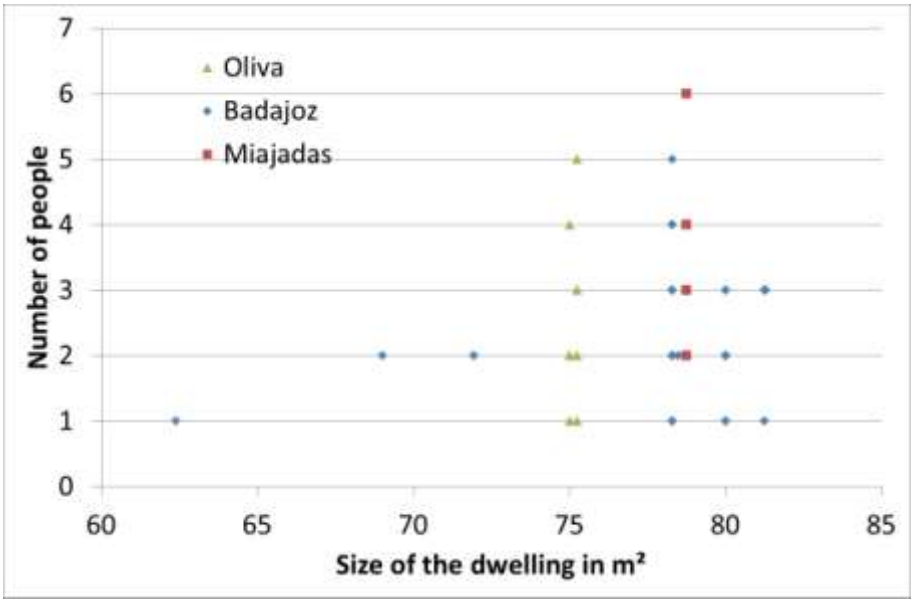
Tenants who logged in the tenant portal were counted as users. In total 70 tenants became active users of the eSESH service. That equates to 60% of the total number of pilot tenants. Those who didn't log in were counted as non-users. Nevertheless, the EAS service was embedded in an extensive awareness campaign which means that all pilot dwellings, EAS non-users too, have been provided with various information materials and electricity saving tips.

4.3.2 Results of consumption data analysis

In the 116 Extremadura pilot dwellings electricity consumption has been measured. Electricity is used for different usages: heating, cooling, domestic hot water, appliances and lighting.

The number of people per dwelling and the size of the dwellings are important elements to be considered in the analysis. The figure below shows that the dwellings analysed are characterised by quite similar surfaces. As forecasted, the larger the dwelling sizes are, the higher the number of people sharing the dwelling is.

Figure 4-43: Number of people in the dwelling related to the size of the dwelling in m²



Before analysing the data it was necessary to cleanse it in order to take into account the changes of tenancy which occurred during the project as well as some incoherencies or periods of absence of the tenants. In these cases the dwellings were excluded from the analysis. As the following table shows data from 78 dwellings were available for saving calculations. That equates nearly 70% of the total number of dwellings. Considering the very low number of dwellings for the site Pallares (n=6) and the need to carry out separate analysis for each site due to the different service implementation starts (see below) this site is not included in the study. The number of dwellings is not representative enough for the calculations.

Table 4-16: Description of the cleansing steps

Site	Site	Number of dwellings	
		before cleansing	after cleansing
Extremadura	Oliva	28	15
	Badajoz	61	47
	Miajadas	17	10
	Pallares	10	6

For calculating the savings a pre-post-comparison has been used which is based on the analysis of the evolution of the electricity consumption figures before and after the implementation of the service. The eSESH EAS service started operation at different dates according to the sites, which implies different baseline and reporting periods and separate site analysis:

- Oliva
  - Implementation of the service: February 2012
  - Baseline : 01/06/2011 – 31/01/2012

  - Reporting : 01/02/2012 – 31/12/2012
- Miajadas
  - Implementation of the service: January 2011
  - Baseline : 01/07/2010 – 31/12/2010
  - Reporting : 01/01/2011 – 31/12/2012
- Badajoz
  - Implementation of the service: December 2011
  - Baseline : 01/01/2011 – 30/11/2011
  - Reporting : 01/12/2011 – 31/12/2012
- Pallares (not included in analysis as explained above)
  - Implementation of the service: February 2012
  - Baseline : 01/01/2011 – 31/01/2012
  - Reporting : 01/02/2012 – 31/12/2012

In addition to pre-post comparisons also comparisons of users and non-users related to the reporting period have been realised. Where possible, furthermore a combined reflection of measured consumption data and via tenant surveys reported consumption behaviour or the like have been carried out (see below).

Global results of electricity data analysis

The global calculation of savings by Extremadura sub-sites following a pre-post comparison led to the results shown in the following table. Therefore, savings from 6 up to 13 % electricity have been observed which equates to savings of more than 21 thousands kWh per year at all three sub-sites together.

The in D7.1 described expected savings of 12% have been achieved. In total 11.5% savings could be calculated. Even the result at the sub-site Oliva (13.3 % savings) was well above expectations.

Moreover, these graphs show that the site of Miajadas is characterized by lower levels of consumptions than the other sites. This is one of the explanations for the lower savings calculated for this site.

Table 4-17: Overview of global results in Extremadura (EAS)

Key data				
	Badajoz Electricity	Oliva Electricity	Miajadas Electricity	Total
Number of dwellings	47	15	10	72
Surface area (average)	78	75	79	78
Number of people (average)	2,17	2,47	2,90	2,33
Global Results for the dataset of dwellings				
	Badajoz Electricity	Oliva Electricity	Miajadas Electricity	Total
Savings (%) - eeMeasure	12,00%	13,30%	6,40%	11,50%
Saving (kWh/yr or m3/yr) - eeMeasure	14 441	5 485	1 614	21 540
Carbon Dioxid Reduction in kgCO2/yr - eeMeasure	9 228	3 505	1 031	13 764
Financial Saving (€/yr) - eeMeasure	3 018	1 146	337	4 501
Consumption Before Intervention (kWh/yr)	120 505	41 152	25 124	186 781
Results per dwelling or per people				
	Badajoz Electricity	Oliva Electricity	Miajadas Electricity	Total
Consumption Unit	(kWh/m².year)			
Consumption - Before intervention	33	33	26	32
Consumption - After intervention	28	29	24	27
Consumption Unit	*(kWh/dwelling.year)*			
Consumption - Before intervention	2 564	2 475	2 011	2 469
Consumption - In the same country*	2307* (Only for Lighting and Electrical Appliances)			
Saving (kWh/dwelling.yr or m3/dwelling.yr)	307	366	161	299
Carbon Dioxid Reduction in kgCO2/dwelling.yr	196	234	103	191
Financial Saving (€/dwelling.yr)	64	76	34	63
** See references*				

For electricity, it is important to compare the levels of annual electricity consumption per m². The charts below shows that the consumption of the dwelling is not correlated to its size which is due to the imponderables of any dwellings (TV, household appliances…).

The two below charts show a global decrease of electricity consumption – from an average of 32kWh/m² to an average of 27kWh/m². This global decrease involves all the kinds of dwellings, larger as well as smaller.

Moreover, these graphs show that the site of Miajadas is characterized by lower levels of consumptions than the other sites. This is one of the explanations for the lower savings calculated for this site.

Figure 4-44: Annual Electricity Consumption (in kWh/m²) related to the surface of the dwelling in m², in 2011

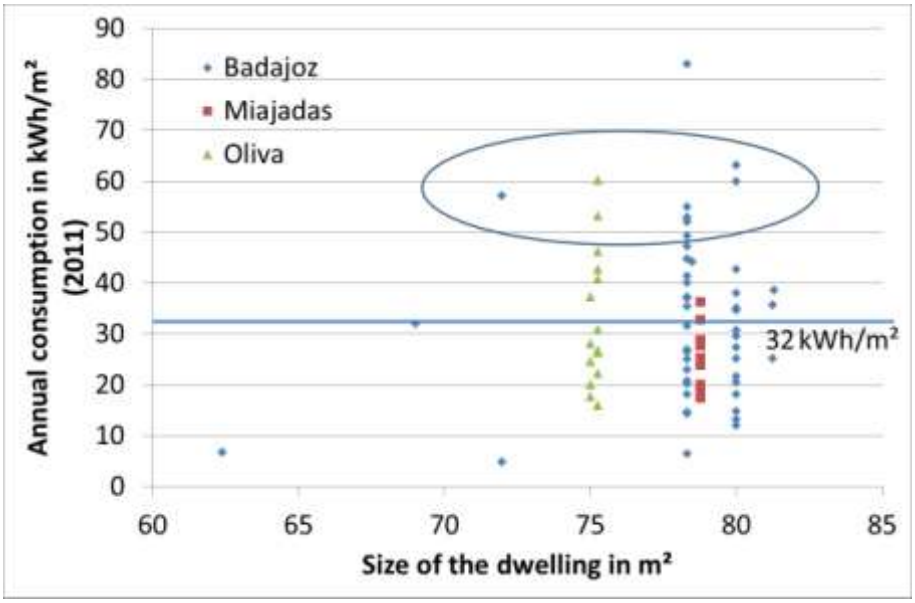
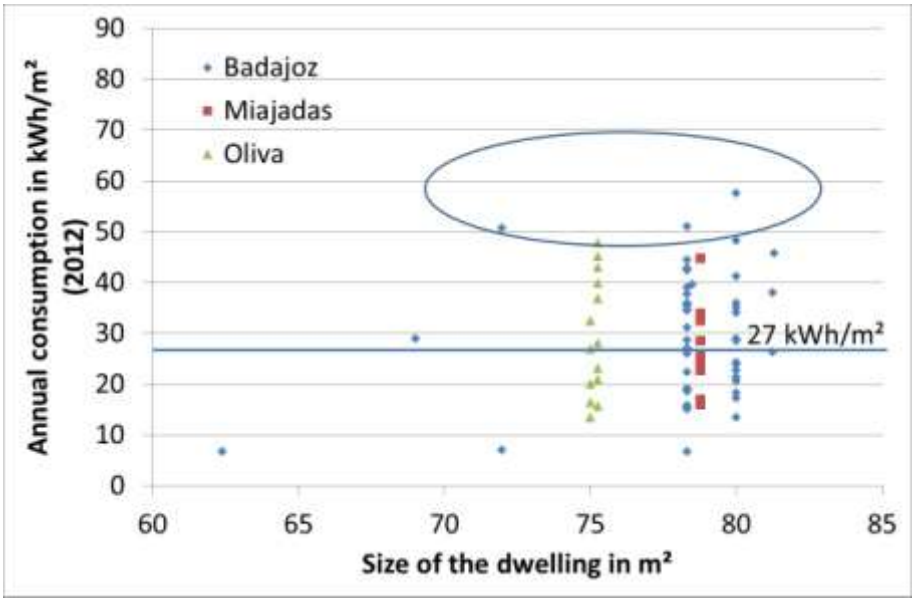
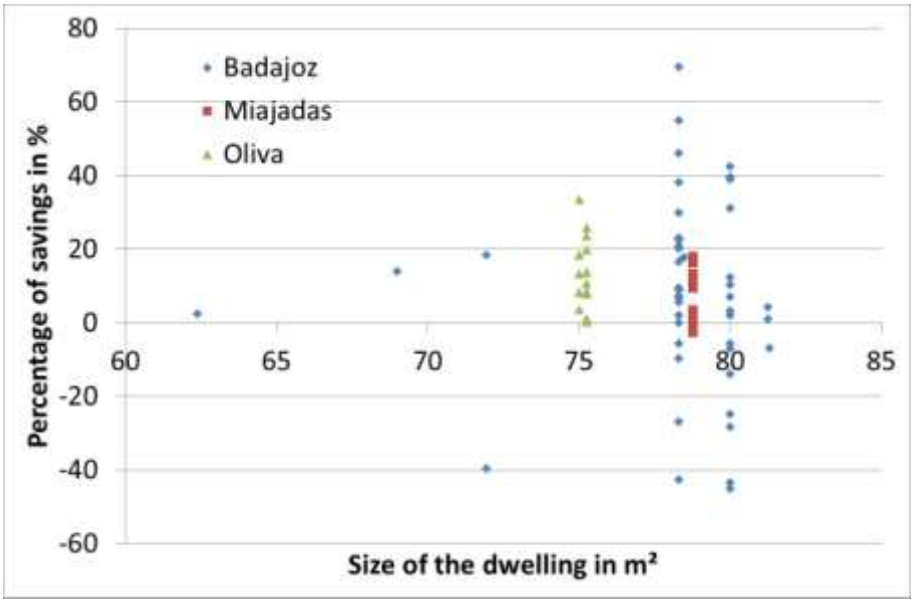


Figure 4-45: Annual Electricity Consumption (in kWh/m²) related to the surface of the dwelling in m², in 2012



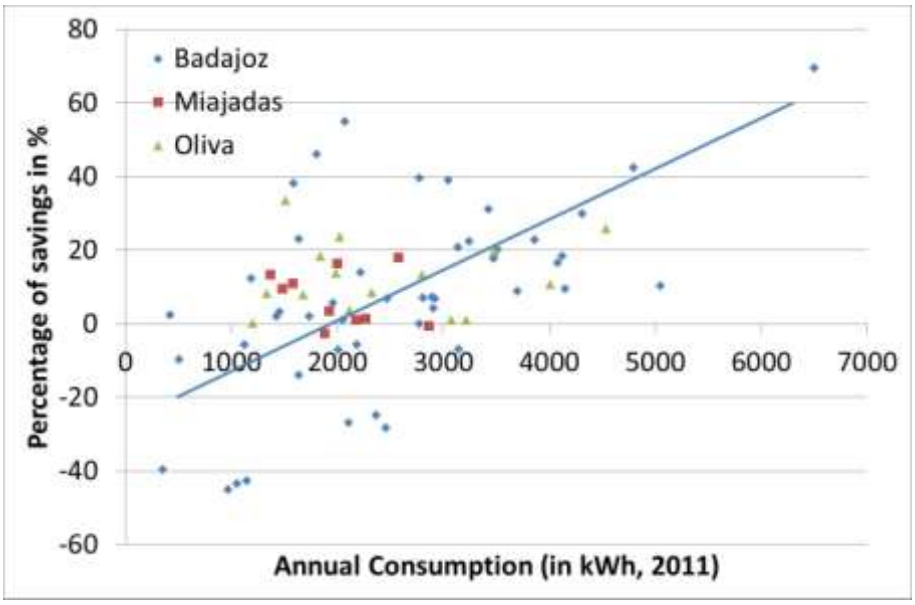
It is furthermore interesting to study the relation between the percentage of savings and the size of the dwelling. It appears that a large majority of the dwellings made savings. Indeed, nearly 80% of the dwellings achieved savings, in Miajadas and Oliva, nearly all the tenants made savings. As can be observed thanks to this graph, there is no correlation between the size of the dwelling and the percentage of savings.

Figure 4-46: Percentage of savings (+ values) related to the surface of the dwelling in m²



To follow, the surface of the dwelling has been replaced by the annual electricity consumption of the baseline period. In doing so, the following figure shows the tendency that high consumers achieved higher percentages of electricity savings than the low consumers.

Figure 4-47: Percentage of savings (+ values) related to annual electricity consumption in kWh, in 2011



Lastly, it is important to compare the baseline level of consumption of the pilot tenants with the national level of consumption. For lighting and electrical appliances the level of consumption for Spain equals 2307kWh per dwelling and year. In the eSESH project the levels of consumption before implementation, which include not only lighting and electrical appliances, but also hot water, heating and cooling, are close to 2200kWh per dwelling and year. Thus, there is a huge gap

between both consumptions. It can be assumed, that the national level (if it would be also related to DHW, heating and cooling) would be at least twice the value calculated for the Extremadura pilot sites. As a consequence, the feasible savings for the tenants are limited.

Comparison between Users and Non-Users of the service

A comparison between users and non-users has been carried out for the site of Badajoz only. For the other sites a comparison based on a pre-post calculation was not useful due to the small number of users (Oliva) or the small number of non-users (Miajadas). The following table gives an overview of the distribution of users and non-users before and after data cleansing. Moreover, as described above, it was not possible to consider all sites together because of different implementation dates of EAS

Table 4-18: Distribution of users and non-users in the consumption dataset & Results

Comparison between users and non-users			
		Badajoz Electricity	
Total of dwellings	Users	31	66%
	Non Users	16	34%
	Total	47	100%
Surface per dwelling	Users	79,10	
	Non Users	76,66	
People per dwelling	Users	2,29	
	Non Users	1,94	
Average Annual Consumption 2011 (baseline period)	*Unit*	*kWh/(dw.year) in 2011*	
	Users	2832	
	Non Users	1756	
% of dwellings which made savings	Users	74%	
	Non Users	69%	
	Total	71%	
Savings (%)	Users	11,70%	
	Non Users	12,60%	

The above table further shows, that 74% of the EAS users made savings. The percentage of non-users with savings is with 69% smaller. Besides, as the comparison based on a pre-post comparison shows, non-users had slightly higher savings than the users of the web portal. In order to analyse this more carefully, a distinction has been made between weak users of the portal and moderate resp. heavy users. The portal use frequency has been measured by special software so as among the web portal users these different categories of users could be defined:

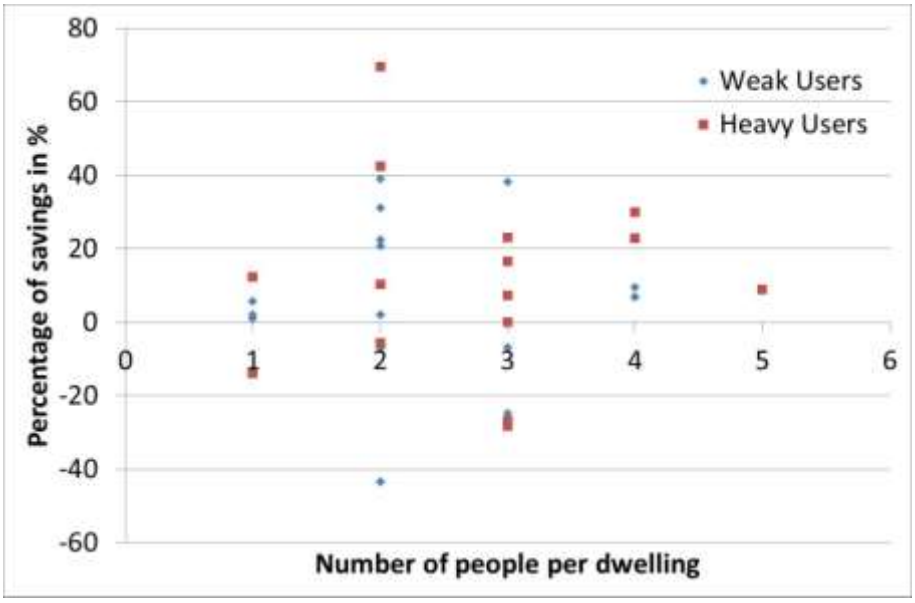
- The weak users who connected themselves to the site less than 6 times
- The moderate users who connected themselves between 6 and 20 times
- The Heavy Users who connected themselves more than 20 times

Table 4-19: Distribution of weak users and heavy users in the consumption dataset and results

Comparison between weak users and heavy users		
		Badajoz Electricity
Total of dwellings	Weak Users	16
	Heavy Users	15
	Total	31
Average Annual Consumption 2011 (baseline period)	*Unit*	*kWh/(dw.year) in 2011*
	Weak Users	2482
	Heavy Users	3206
Savings (%)	Weak Users	5,40%
	Heavy Users	17,10%

This analysis shows that the moderate and heavy users of the EAS web portal have very good results – average savings of 17%, whereas weak users achieved 5.4% global savings only. As a consequence, it appears that the weak users involve a bias in the calculation of the global savings. To conclude, the use of this service appears to be a real success.

Figure 4-48: Percentage of savings (+ values) related to the number of people in the dwelling, for weak users and heavy users of the web portal



The pre-post comparison between EAS users and non-users showed that the savings of both groups are on a very similar level. The difference of savings between users and non-users is smaller than expected. Even without EAS use, it can be observed that the tenants achieved significant savings. One reason for that could be the fact that all Extremadura pilot tenants got information about how to save energy from the housing provider. Even if the tenants do not directly

use the service they heard about it and as a consequence, the eSESH service has an indirect impact also on non-users.

Another reason could be the finding of the baseline tenant survey (see below) which stated that non-users already in the baseline period kept an eye on their energy consumption and lived to a large extent energy-consciously. That fact is underlined with the result that non-users had a lower average consumption in the baseline period than users. That means for the eSESH service use, that non-users furthermore followed their already existing firm conviction to live in an energy-saving way without demand for further information by EAS, while later EAS users (especially the heavy users) became within the tenant events aware of their comparably higher consumption and got with the EAS an instrument which motivates them to start to reduce their consumption. That can be also underlined by results of the tenant surveys where users reported – for example – on behavioural changes after using the EAS.

The biggest influence on the energy savings is due to direct awareness actions that have been performed, while the web portal has not been very effective caused by lacks of knowledge and missing skills in using computers and internet. At the beginning, non-users were not very interested in participating in the project eSESH because they had very low energy consumption bills and indicated that they were already carrying out energy saving habits. It is also important to note that the Extremadura pilot worked in the same way for both users and non-users to promote the awareness campaign by giving tips on how to consume optimally, by providing personalised reports on energy savings by responding to their questions, etc.

4.3.3 Results of tenant survey analysis

The Extremadura pilot site carried out two tenant surveys – the first one in September 2011 as part of the baseline period. The second stage has been realised one year later in the reporting period in October 2012. In total, 78 of the 116 pilot tenant households (67 %) participated in the first stage of the panel study, 71 households (61 %) in the final stage. The respondent households live either in Miajadas or Badajoz. In the below following survey analysis included are the responses of 62 tenants (53 % of total) who participated in both stages of the longitudinal study. The remaining questionnaires have not been considered because of missing data of the first or the second survey stage partly caused by a change of tenancy.

Both surveys mainly focussed on the equipment with and the use of (electrical) appliances as well as on aspects of reported energy consumption behaviour. In addition to that, the second survey contained questions regarding the user satisfaction with the provided EAS.

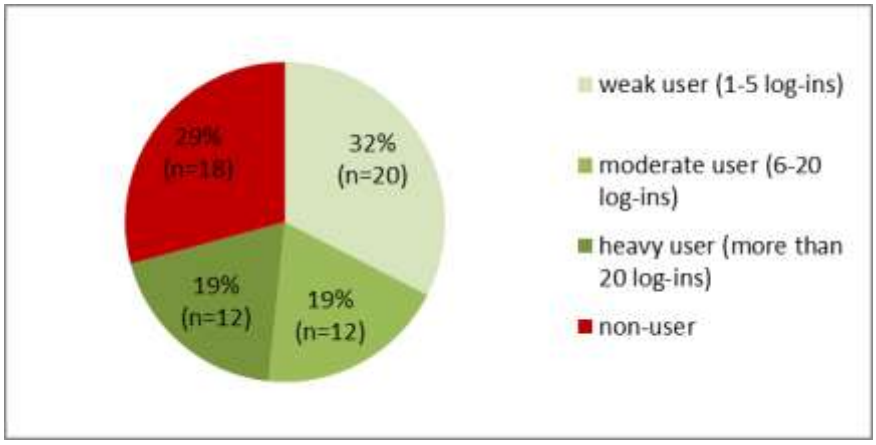
EAS use and socio-demographic characteristics

Among the respondents in the sample are 44 users of the tenant portal (71 %), who use the EAS more or less regularly[9]. The usage ranges from 1 up to 126 visits in the reporting period. On average the respondents logged in for 17 times. 18 respondents (29 %) still do not use the EAS, but - as described below in the context of reported satisfaction with EAS– most of them have

[9] That information bases on the measured portal log-ins.

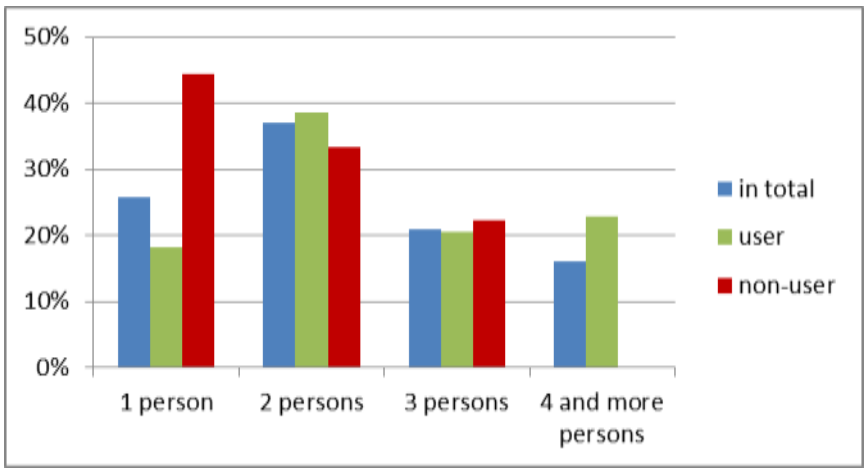
already got an impression on its functionality, e.g. in the context of tenant events or visits of an energy coach.

Figure 4-49: Number of users and non-users of the EAS in the tenant survey sample of Extremadura



Respondents living in multi-person households are currently rather more interested in EAS than people living in single households. That especially applies to families with children under 12 years old. 80 % of those families are regular users of EAS.

Figure 4-50: Household size of respondents in total and by user/non-user

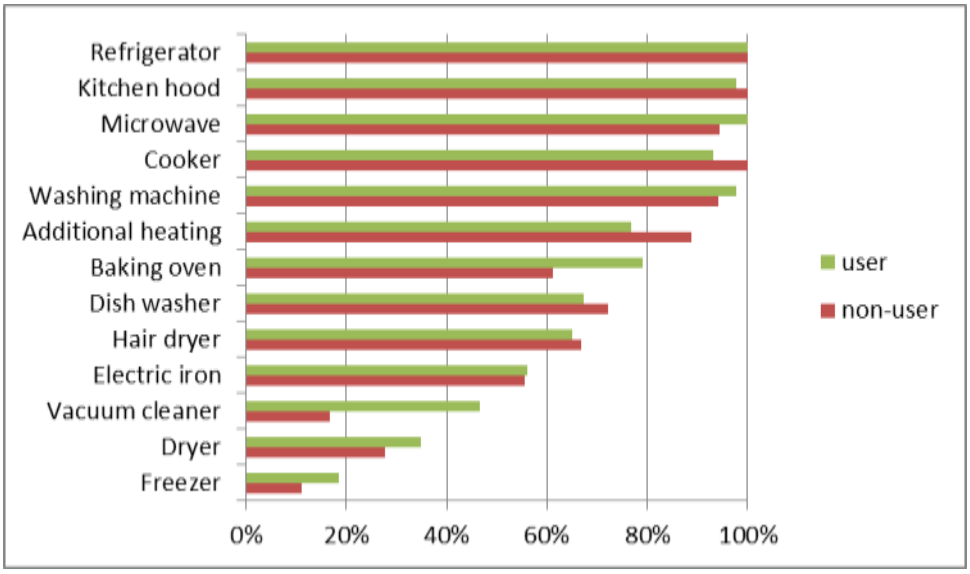


Equipment with and usage of electrical appliances

In both stages of the tenant survey the respondents were asked to give information about the available electrical appliances and devices. Nevertheless, the comparison of both stages showed marginal changes only. The comparison of current users and non-users of the EAS shows that the equipment with household appliances is very similar. Refrigerators, kitchen hoods, micro waves, cookers and washing machines exist in nearly each respondent household. In contrast to that, only a few households have freezers and/or dryers available.

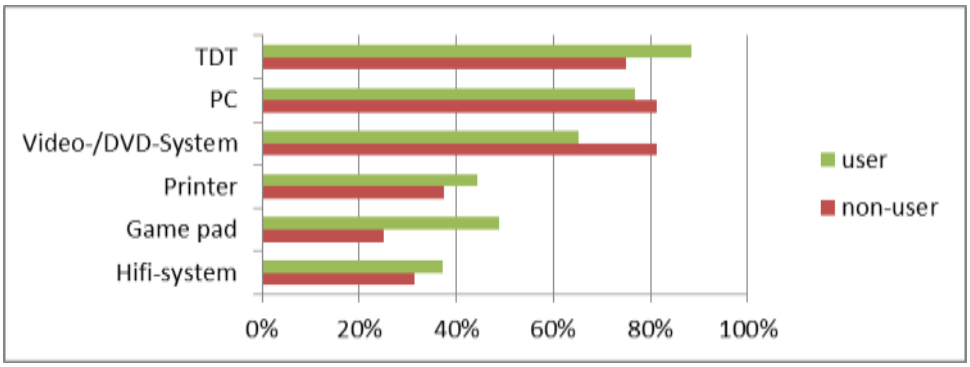
The energy efficiency label of the existing refrigerators seems to be more or less up to date. Only two respondent households (one user, one non-user) are equipped with refrigerators which are more than ten years old. 98 % of the users and 94 % of the non-users have refrigerators with defrost function.

Figure 4-51: Equipment with electrical appliances of users and non-users



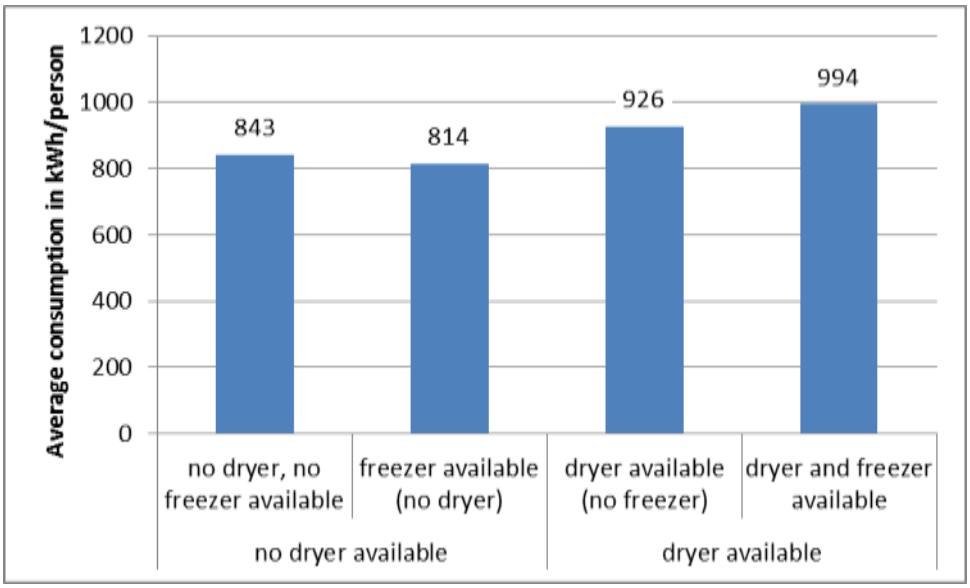
Except Video-/DVD-systems and PCs which are slightly more often available in non-user households, EAS users are more often equipped with all the rest of the consumer electronics shown in the following figure. Nevertheless, the differences between both groups are not statistically significant. EAS users who – as seen above – often live in families with children especially more often use game pads than non-users.

Figure 4-52: Equipment with consumer electronics of users and non-users



Especially dryers, but also freezers have a big impact on electricity consumption. Those respondents who have a dryer available have an 18 % higher consumption compared to households without dryers and freezers available. That result can be used to give additional information about alternative possibility to dry their laundry.

Figure 4-53: Average consumption in kWh/person (2012) related to reported equipment with dryers and freezers



Part of the baseline tenant survey (before EAS implementation) was the collection of survey data regarding the use of appliances. The comparison of current users and non-users of EAS shows that the non-users reported at the beginning of the project more often about energy efficient consumption behaviour than users. Compared to users the current non-users of EAS:

- more often defrost their food in the fridge (22 % non-users compared to 7 % users),
- use their dish washers, dryers, washing machines and vacuum cleaners less frequently and
- slightly rather use their washing machines in full load only.

The bigger the household size of a user household the higher was the use frequency of the available appliances. That could be one of the reasons why households with four and more members are already active EAS users in order to reduce their comparably higher energy consumption and energy costs.

Table 4-20: Use of electrical appliances by users and non-users

Aspects	value labels	User	Non-user
How often do you use your washing machine?	daily	9.5%	5.9%
	up to 3 times per week	47.6%	41.2%
	weekly	42.9%	52.9%
Do you wash your clothes in hot water?	yes, always	7.1%	5.6%
	yes, often	4.8%	5.6%
	yes, sometimes	31.0%	27.8%
	no	57.1%	61.1%
Do you use your washing machine in full load only?	yes	38.1%	35.3%
	no	61.9%	64.7%
How often do you use your dryer?	up to 3 times per week	47.1%	20.0%
	weekly	35.3%	80.0%
	less frequently	17.6%	
How do you defrost your food?	microwave	27.9%	16.7%
	refrigerator	7.0%	22.2%
	window sill	65.1%	61.1%
How often do you use your dish washer?	daily	7.4%	9.1%
	up to 3 times per week	48.1%	9.1%
	weekly	37.0%	81.1%
	less frequently	7.4%	
How long do you use a vacuum cleaner or another cleaning machine?	up to 1 hour per week	70.0%	80.0%
	1-3 hours per week	25.0%	20.0%
	4-6 hours per week	5.0%	

Before-after-comparison of energy consumption behaviour

Exemplary aspects of energy consumption behaviour have been asked consistently in both stages of the tenant survey. That procedure allows comparisons of behaviour patterns of EAS users reported before the use of the tenant portal and after an adequate use period. As Table 4-21 shows, there are behavioural changes in terms of optimised energy consumption obvious:

- Now one third of the users with heating systems (33 %; compared to 5 % at the beginning of the project) chose a winter room temperature of less than 21 °C.
- Now more than two thirds of the users with air conditions (69 %; compared to 43 % at the beginning) select with 23 °C and more degrees a higher room temperature for cooling.
- Now 88 % of all users (compared to 79 % at the beginning) always switch off the light when they leave a room.
- The percentage of users who leave their electrical devices on stand-by mode at night decreases from 58 % up to 44 %. Now more tenants totally (33 % compared to 23 % at the beginning of the project) or at least sometimes (23 % compared to 19 % at the beginning) switch off their appliances when going to bed.
- The percentage of users who never switch off their PCs decreased slightly from 19 % up to 16 %.
- The use of energy saving bulbs in the homes is on a high level and nearly constant in time. The proportion of tenant households who don't use energy saving bulbs slightly decreased from 5 % up to 2 %.

The number of TVs in each tenant household is an exception from that positive development. Regarding that topic increasing figures are detectable.

Table 4-21: Pre-post-comparisons of aspects of energy consumption behaviour (users of EAS only)

Aspects	value labels	Before EAS use	After EAS use
Which room temperature do you have in winter?	< 21 °C	4.8%	33.3%
	21-23 °C	61.9%	33.3%
	23-25 °C	28.6%	28.6%
	> 25 °C	4.8%	4.8%
At what temperature is your air condition running?	< 21 °C	8.7%	7.7%
	21-23 °C	47.8%	23.1%
	23-25 °C	43.5%	57.7%
	> 25 °C		11.5%
Do you switch off the light when you leave the room?	yes	79.1%	88.4%
	sometimes	20.9%	11.6%

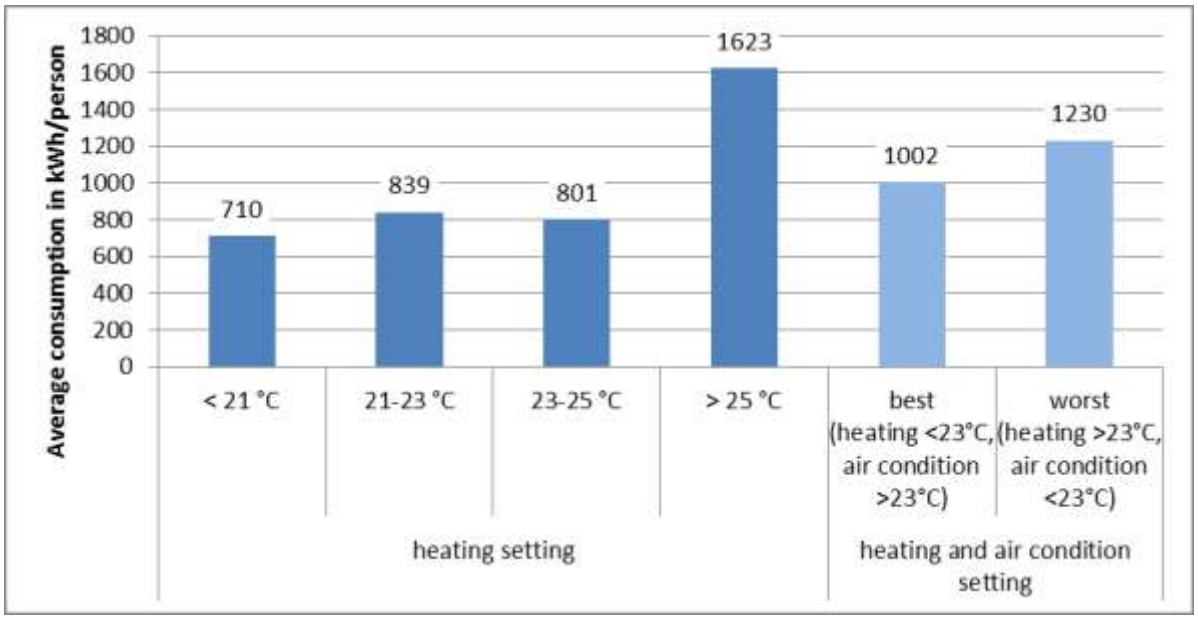
Aspects	value labels	Before EAS use	After EAS use
How do you switch off your devices at night?	all are on stand-by	58.1%	44.2%
	all are totally switched off	23.3%	32.6%
	some are switched off	18.6%	23.3%
Do you use energy saving bulbs?	yes, all over	57.1%	58.1%
	yes, some	38.1%	39.5%
	no	4.8%	2.3%
How many hours do you use your PC per day?	< 1 hour	32.3%	25.0%
	1-3 hours	35.5%	43.8%
	4-6 hours	12.9%	15.6%
	24 hours	19.4%	15.6%
How many TVs do you have in your home?	one	51.2%	32.6%
	two	44.2%	48.8%
	more than two		16.3%
	none	4.7%	2.3%

Especially regarding the chosen room temperatures in winter (heating) and summer (air condition) which have a comparably big impact on electricity consumption the link to the savings calculation of the consumption data analysis showed that

- 60 % of those respondents who reported in the final survey to have a room temperature in winter of less than 21 °C have general savings greater than 20 % electricity consumption. Further 20 % have savings up to 20 % electricity.
- 31 % of respondents who reported an energy efficient air condition setting of more than 23 °C achieved general savings of more than 20 % electricity. Further 38 % had savings between 6 and 20 %.

The big impact of especially heating settings is shown in the following figure. Those respondents who set their heating on room temperatures less than 21 °C have an average electricity consumption which is 129% lower than the average consumption of respondents with room temperatures over 25 °C. In addition to that, those respondents who have both, optimal heating setting (< 23 °C) as well as an ideal air condition setting (> 23 °C), consume on average 23 % less electricity than those tenants with a suboptimal regulation.

Figure 4-54: Average consumption in kWh/person (2012) related to reported heating and air condition settings



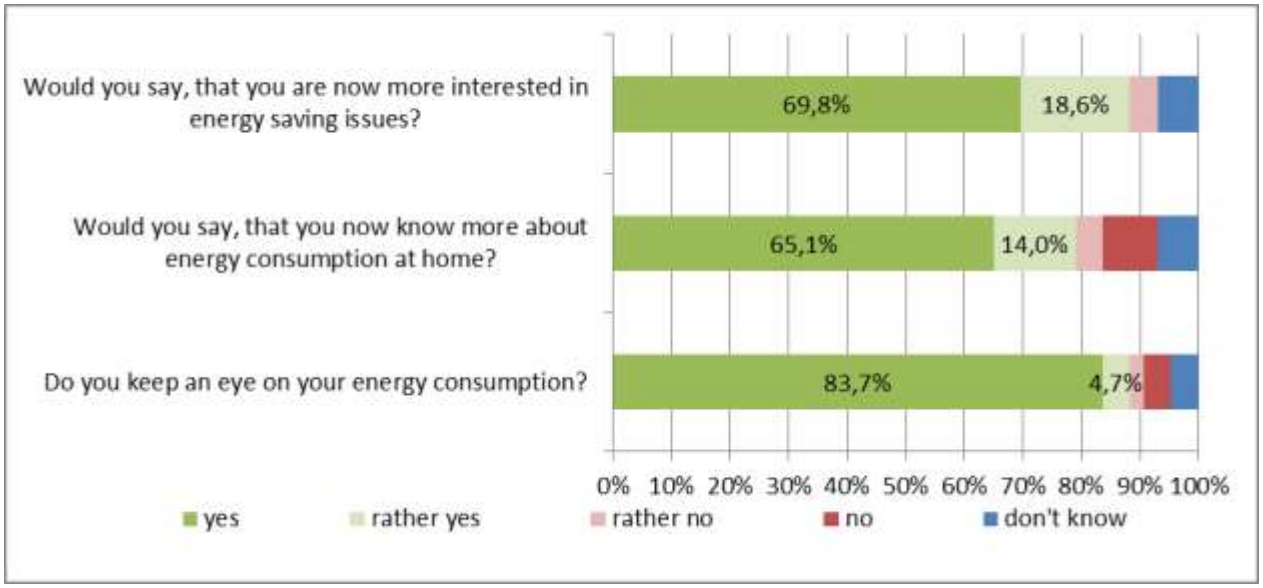
The further comparison of users and non-users showed that users reported in the final survey a more energy efficient heating and cooling behaviour than non-users (see Table 4-22).

Table 4-22: User non-user comparisons of aspects of energy consumption behaviour (statements of the final tenant survey only)

Aspects	value labels	User	Non-user
Which room temperature do you have in winter?	< 21 °C	33.3%	20.0%
	21-23 °C	33.3%	20.0%
	23-25 °C	28.6%	40.0%
	> 25 °C	4.8%	20.0%
At what temperature is your air condition running?	< 21 °C	7.7%	12.5%
	21-23 °C	23.1%	25.0%
	23-25 °C	57.7%	37.5%
	> 25 °C	11.5%	25.0%

By means of the EAS nearly 9 from 10 users stated that they now can keep an eye on their energy consumption (“yes” and “rather yes”). A further positive result of using EAS is that 70 % of the respondents in the final survey reported, that they are now more interested in energy saving issues. Further 19 % respondents partly agreed. In addition to that, 65 % totally and 14 % partly agreed that they now know more about their energy consumption at home.

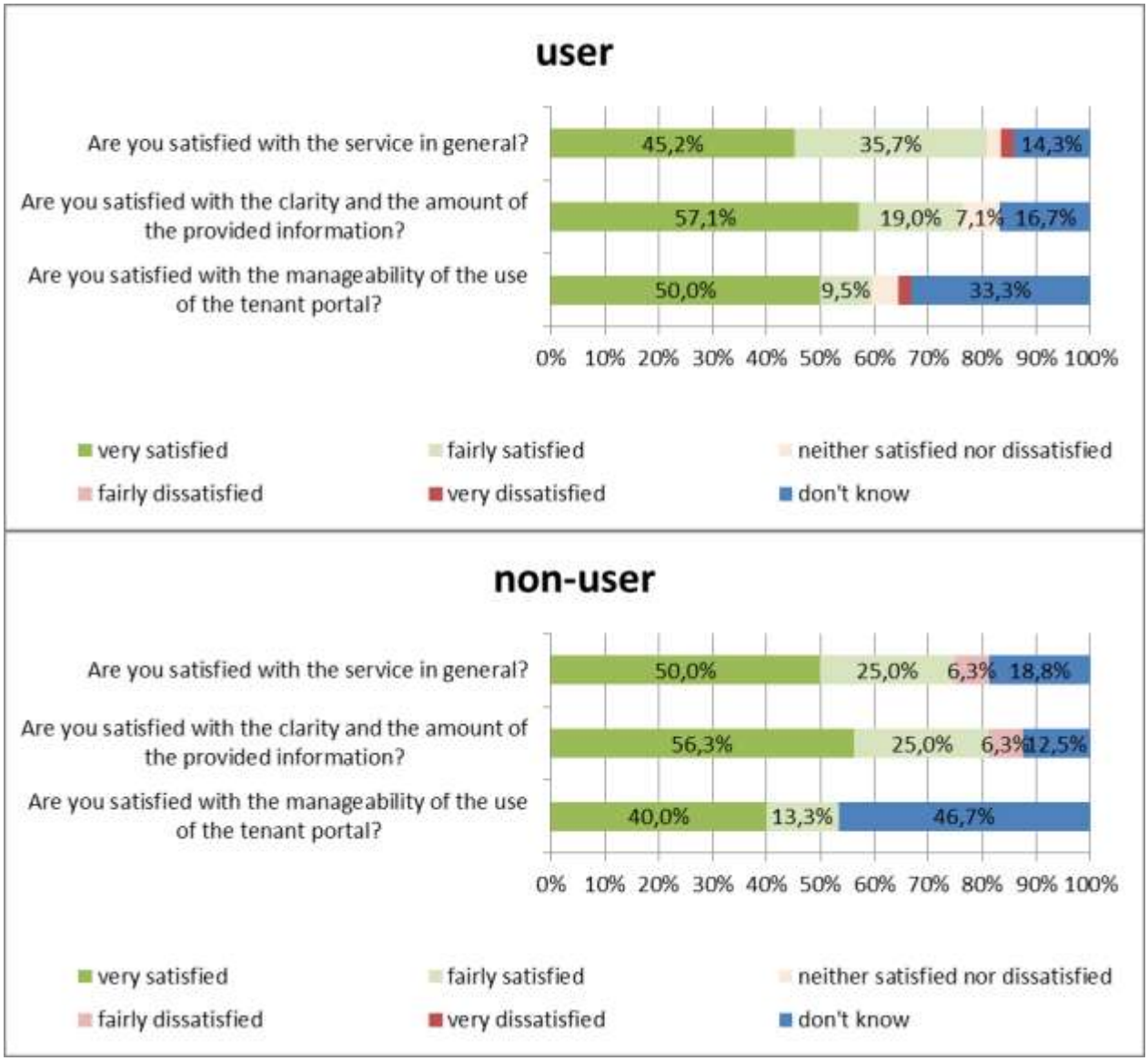
Figure 4-55: Changed attitudes after EAS use (users of EAS only)



Satisfaction with EAS

One part of the final survey which was addressed as well to users and non-users was the assessment of the quality of EAS. As already mentioned above all pilot tenants have been invited to tenant events when introducing the provided EAS and giving energy saving hints. That's the reason why also a lot of current non-users of EAS were able to give their first impressions regarding the satisfaction with the provided tenant portal. As shown in the following figure 81 % of the EAS users and 75% of the non-users are very resp. fairly satisfied with the EAS in general. A similar quantity (76 % of users, 81 % of non-users) is satisfied with the clarity and the amount of the provided information. The manageability of the EAS tenant portal can be optimised. There reported a comparably smaller number of respondents (60 % of the current users and 53 % of the non-users) to be very resp. fairly satisfied.

Figure 4-56: Satisfaction with EAS (users and non-users)



In a further question stated 89 % of the current non-users of EAS that they are interested in the future use of the tenant portal (after the eSESH project). The same applies to further energy saving measures

4.4 Frankfurt

4.4.1 Background information

The Frankfurt eSESH service contains two components based on a web portal – the EAS and the EMS.

The energy awareness service for tenants (EAS) consists of a web portal resp. a smart phone app with monthly updates to check and control the household's heating and warm water consumption. It contains hints and tips for energy saving and is available in German, English and Turkish. The main components of the EAS web portal are:

- Benchmarking and comparison features (previous consumption periods on a monthly and annual basis, average consumption of all dwellings in the same property)
- Forecasting: Tenants can see whether their pre-payments are in line with their actual costs of energy consumption
- Saving tips
- Alerts by email when updated consumption figures are available
- Additional monthly reports summarising the energy consumption of the tenant which are generated automatically by the energy web portal and sent to tenant by email

In addition to that the housing company can generate on demand a report summarising the energy consumption of a tenant (e.g. in order to identify and to contact selectively 'high consumers') and/or of the whole property (e.g. in order to make decisions on priorities for a fundamental rehabilitation easier by providing the opportunity to compare different properties or buildings).

Figure 4-57: Screen shots of the web portal

Apart from technical recommendations the energy management service (EMS) is for improving energy efficiency and includes advice on immediate actions for reducing energy consumption resp. energy costs. By using the 'Heating ECG' for example, heating system deficiencies, faulty adjustments or damage can be specifically identified and systematically remedial action can be taken during the heating period or before the next heating period starts. The efficiency of the

heating system components are continuously monitored by specific measuring methods. Analysis carried out within the scope of the eSESH project identifies any potential trouble spots in the heating system and visualises potential optimisation options.

In addition, any losses within the property's energy supply can be analysed and optimised using the EMS 'Permanent Heating Monitoring'. Clear technical findings about the performance of the heating system and recommendations can be provided by the energy service provider. These recommendations are used by the housing provider to make optimisation changes to the heating system. Based on the implemented optimisations changes, the energy service provider then monitors the heating system again to check if the results are satisfying or if further optimisation changes are needed.

In order to invite and to motivate pilot tenants to make use of the EAS several activities have been carried out. Tenant meetings and service hours started in September 2011. A tenant letter with further information including an information brochure was communicated prior to EAS access code early November 2011. Due to several tenant move ins/outs and few active users at the beginning of 2012[10] the tenants have been informed by ista a second time in early February 2012 and a third time in October 2012. The regular tenant service hours of the housing provider were used for the same purpose. In addition to that, posters have been placed in the staircases. Further promotion material (including press article) have been promoted on the websites of ista (www.ista.de) and Nassauische Heimstätte/Wohnstadt (www.naheimst.de).

In August 2011 ista carried out staff trainings and introduced the EAS technology to NH/Wohnstadt staff (tenant contact persons as well as staff from the operational expenses department).

In total, 242 dwellings were – as originally planned – involved in the Frankfurt pilot, which are located at two pilot sites. In addition to that, further 116 dwellings have been included for increasing the observation sample for more generalizable results analysing the impact of the EMS component 'Heating ECG'.

Table 4-23: Overview of the number of buildings and dwellings involved in the Frankfurt pilot

Site	Pilot site name	Number of buildings involved	Number of dwellings involved
Frankfurt	Stadtallendorf	4	90
	Eschwege (Oderstraße)	15	152
	Eschwege (Lindenweg): EMS 'Heating ECG' only	19	116

Because of data protection reasons measured portal log-in data are not available in Frankfurt. That's why the differentiation of EAS user and non-users of the tenant web portal is based on the registration to the portal. Tenants, who logged into the web portal (that means tenants who received a personal password-protected access and logged in at least once), were counted as users. Tenants who did not log in once were counted as non-users. In total, 33 of the 242 pilot tenants (13%) became EAS users.

[10] 15 registered users in January 2012

4.4.2 Results of consumption data analysis

In Frankfurt, 242 dwellings have been equipped with the eSESH EAS and EMS service. The consumption measurements were related to energy used for heating and domestic hot water (DHW). As described above further 116 dwellings have been equipped with the EMS service.

Before analysing the data, it was necessary to cleanse it in order to take into account the change of tenancy as well as some incoherencies or periods of absence of the tenants. In those cases, the dwellings were excluded from the data analysis. As the following table shows, 149 of the total number of 242 dwellings have been included in the data analysis regarding EAS which represents nearly 62% of the whole dataset The comparably high drop-out of 38% of the EAS dwellings is due to the comparably longer baseline period which covers three years instead of elsewhere one year. That implies a relevant higher number of tenant changes, etc.

Table 4-24: Description of the cleansing step

Site	Data	Number of dwellings	
		Before cleansing	After cleansing
Frankfurt (EMS)	Heating and Hot Water	358	358
Frankfurt (EAS)	Heating and Hot Water	242	149

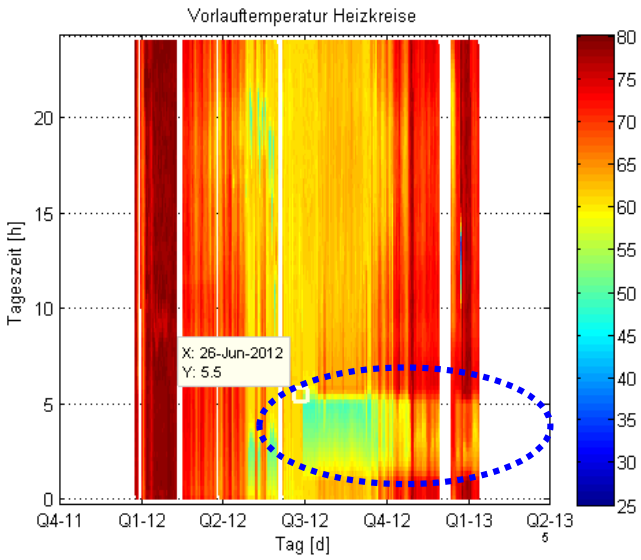
Related to EMS measurements the total number of dwellings (original 242 + additional 116 dwellings) has been observed.

For calculating the savings a pre-post comparison has been used. The pre-post comparison is based on the analysis of the evolution of the heating and hot water consumptions before and after the implementation of the service. The heating system (gas condensing boilers) supplies both space heating and domestic hot water. The date of implementation of the eSESH service (EAS and EMS) was January 2012. Thus, the baseline period (Feb 2009 – Dec 2011) is compared to the reporting period (Jan 2012 – Dec 2012).

Results of heating and hot water data analysis – EMS

With the ‘Heating ECG’ – one main component of the Frankfurt EMS – could be detected that the heating systems in Stadtallendorf and Eschwege which supplies space heating as well as domestic hot water ran without adequate cycle times for the flow temperatures of the heater loops. The hot water supply implies that a total switch-off mode of the heating system in summer (heating limit 15 °C) is not possible, but an automatic lowering at night in the summer month could show first saving results. The EMS further shows that the condensing boiler achieves an average degree of efficiency of only 81% instead of the typical average figure of 89%. Another result is the observed too high frequency of switch on/switch off mode of the second boiler in the transitional period. Both boilers are not enough synchronised.

Figure 4-58: Flow temperatures of the heater loops with an automatic night lowering from June to August 2012



Due to the EMS start in January 2012 a second - and then complete – heating period is necessary to evaluate the impact of the optimisation of the condensing boiler (hydraulic balancing) and the better synchronisation of the second boiler. First good results can be reported regarding the automatic flow temperature lowering at night in summer month (hot water supply only). Between 1 and 5 o'clock at night now the flow temperatures for water heating are reduced which

- led to 9% savings projected to all three properties (358 dwellings)
- which equals in total 18,500 saved kWh per year (without heating period)
- which equates to a CO_2 reduction of nearly 4,400 kgCO_2/year
- and about 1,100 saved € per m^2 and year.

It is to expect, that the EMS will led to much higher savings extended to the next heating period which cannot be quantified yet.

Compared to the expected savings of 10% for EMS the result of 9% savings (DHW heating) in the summer period can be assessed as success. That positive result is furthermore underlined by the above described fact, that further improvements already detected by EMS are 'ready for take-off' in the next heating period and will very likely lead to additional significant savings.

Results of heating and hot water data analysis – EAS

In addition to that, the calculation of the savings due to EAS usage resp. due to increased energy awareness as a consequence of the Frankfurt tenant approach led to global savings of about 4%. That equates – related to the 149 analysed pilot dwellings – in total nearly 36.000 saved kWh per year and more than 8.5 tons CO_2-reduction.

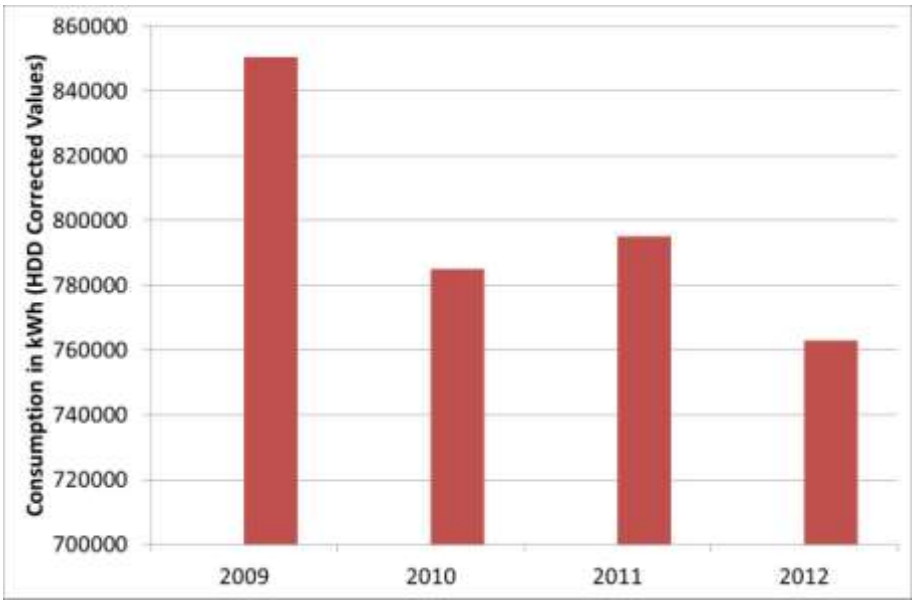
In addition to that the calculation of the savings related to EAS led to global savings of 10% if only the years 2009 and 2012 are considered.

Table 4-25: Overview of global results in Frankfurt (EAS)

Key data	
	Heat & Hot water
Number of dwellings	149
Surface area (average)	61
Number of people (average)	-
Global Results for the dataset of dwellings	
	Heat & Hot water
Savings (%) - eeMeasure (weighted)	4,10%
Saving (kWh/yr or m3/yr) - eeMeasure	35 943
Carbon Dioxid Reduction in kgCO2/yr- eeMeasure	8 518
Financial Saving (€/yr) - eeMeasure	2 157
Consumption Before Intervention (kWh/yr)	850 439
Savings (%) (Weighted) based on the years 2009 and 2012	10%
Results per dwelling or per people	
	Heat & Hot water
Consumption Unit	*(kWh/m².year)*
Consumption - Before intervention	94
Consumption - After intervention	84
Consumption Unit	*(kWh/m².year)*
Consumption - Before intervention	94
Consumption - In the same country*	188*
Saving (kWh/dwelling.yr or m3/dwelling.yr)	241
Carbon Dioxid Reduction in kgCO2/dwelling.yr	57
Financial Saving (€/dwelling.yr)	14
** See references*	

These global savings of 4%, calculated with eeMeasure, are based on the four-years-comparison. Nevertheless, as the following chart shows a calculation of savings based on a comparison of the years 2009 and 2012 only would lead to a higher savings figure up to 10%. The eSESH service started operation in January 2012, but the eSESH project embedded in an awareness campaign began earlier and might have had already an impact in 2010 and 2011.

Figure 4-59: Annual consumption in kWh (HDD Corrected Values) in 2009, 2010, 2011 and 2012



However, also the overall savings of about 4% can be interpreted as a good result. As the above table shows, the average heating/DHW consumption of Frankfurt pilot tenants is less than half of the German average which might be caused by smaller than average dwelling sizes. That implies that the energy saving potential of Frankfurt pilot tenants is limited because these tenants already consume significantly less energy compared to German average households and, as a consequence, their possibilities are limited in terms of feasible savings.

For heating it is important to relate the consumption to the dwelling size. In doing so, it can be observed a decrease of the total consumption between 2009 and 2012 (see both following figures). That especially applies to the circled ‘high consumers’ who showed a tendency to make more savings. In total, 53% of the pilot dwellings achieved savings which is a promising result.

Figure 4-60: Annual Consumption (in kWh/m²) related to the surface of the dwelling in m², in 2009

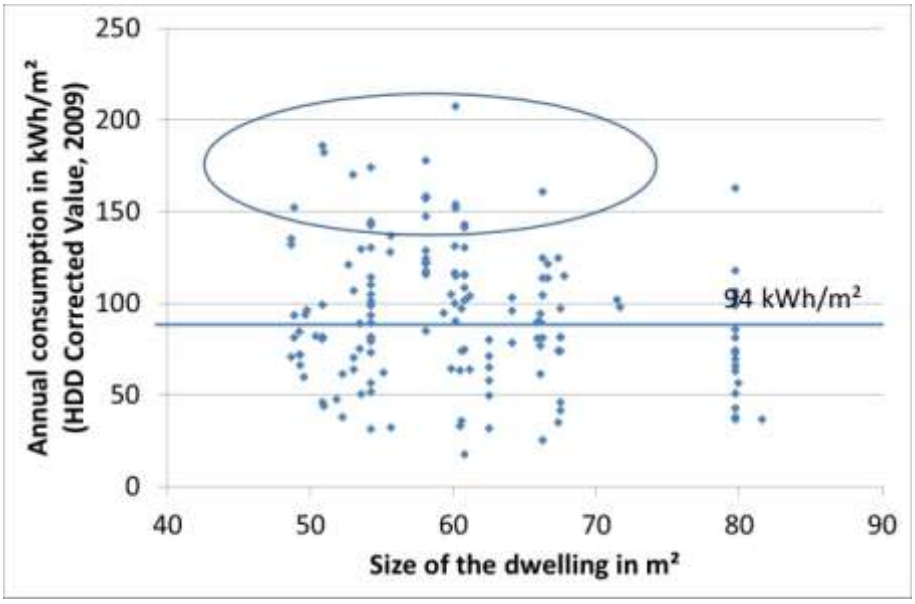
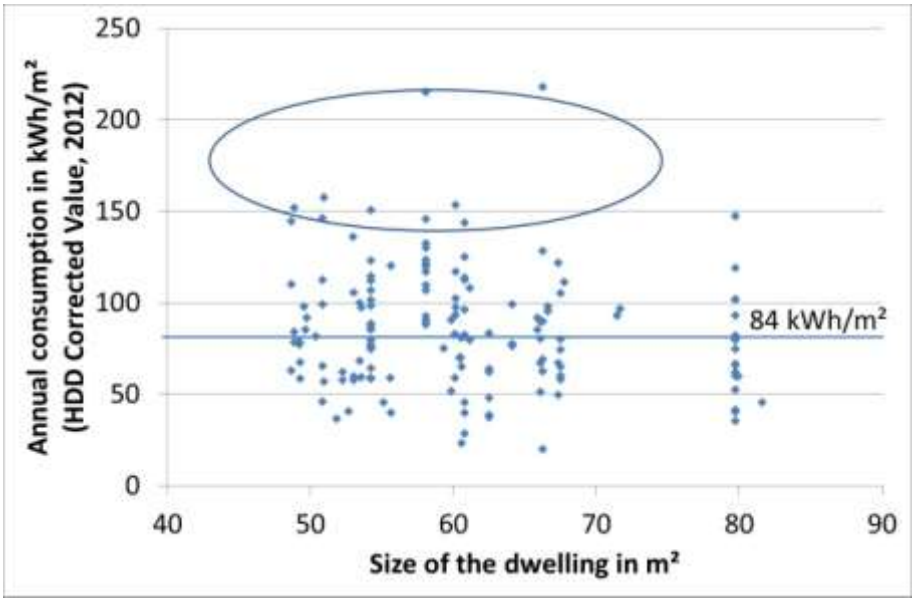
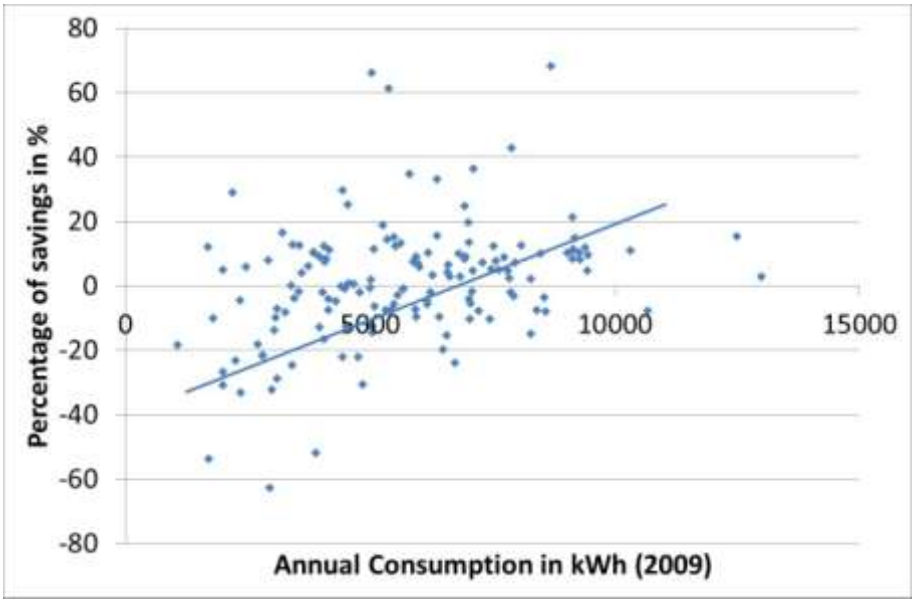


Figure 4-61: Annual Consumption (in kWh/m²) related to the surface of the dwelling in m², in 2012



By replacing the dwelling surface by the annual heat energy consumption of the baseline period (2009) the higher saving trend of high consumers becomes obviously.

Figure 4-62: Percentage of savings (+ values) related to the annual consumption in kWh



Comparison between users and non-users (EAS)

The data analysis of users and non-users of the service were based on the distribution shown in the following table. The number of users in the cleansed sample is with 19 tenants comparably low. For information, in total 33 of the 241 Frankfurt pilot tenants (13%) became EAS users. Beside the overall explanation that social housing tenants belong to a “difficult-to-reach” population is a specific characteristic of the Frankfurt pilot site that the tenants there have comparably very low energy bills for heating – on average 350 € instead of 800 € per household and year – which is caused by the smaller than average dwelling sizes. So it can be assumed that the motivation to save energy by using the provided EAS in order to save money is not pronounced for all pilot tenants. Anticipating further below described results of the tenant survey another main explanation for the low usage rate is the high percentage of tenants without internet access.

As the following table shows, 57% of EAS users achieved savings, which is a higher percentage than the figure of 50% non-users who made savings.

As the user/non-user-comparison based on a pre-post calculation further shows, EAS non-users had slightly higher savings than the users of the EAS web portal. An explanation for that result could be that the realised tenant events and information campaign in the eSESH project raised the overall tenant’s awareness which in fact not led to a big number of EAS users, but make them aware for further relevant information provided by other media and sender. Moreover, and as shown through the results from the tenant surveys carried out (see below) it became apparent that the users are those tenants much better informed about energy saving possibilities and showing a significantly higher interest in energy saving opportunities. Already prior to the eSESH project they belonged to the group of energy savers. This needs to be kept in mind when comparing the energy saving figures of both groups.

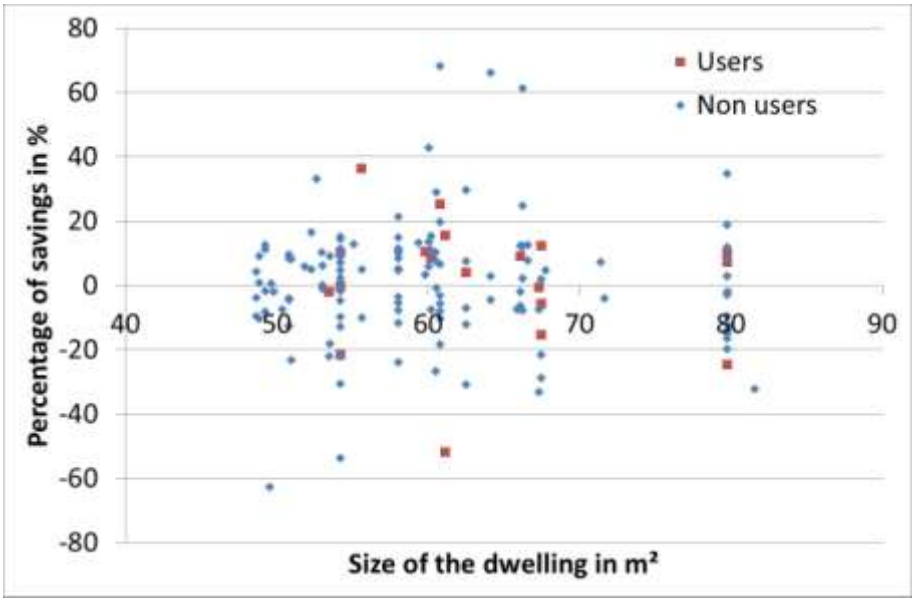
In comparison with the expected savings of 15% for EAS users (described in the evaluation planning deliverable D7.1), the calculated results seem to be below expectation. But, when

summing up the above statements – especially regarding the limited saving potentials due to an already reduced consumption by more than half compared to the German average – it can be assessed as a positive result. In addition to that it is very likely that the number of EAS users can be increased with 'success stories' and with a special motivation of 'high consumers' which can be detected from the EAS web portal – both aspects of the future Frankfurt plans.

Table 4-26: Distribution of users and non-users in the consumption dataset and results

Comparison between users and non-users			
		Heat & Hot water	
Total of dwellings	Users	19	13%
	Non Users	130	87%
	Total	149	100%
Surface per dwelling	Users	63,80	
	Non Users	60,62	
People per dwelling	Users	-	
	Non Users	-	
Average Annual Consumption 2011 (baseline period)	*Unit*	*kWh/(dw.year) in 2011*	
	Users	5371	
	Non Users	5548	
% of dwellings which made savings	Users	57%	
	Non Users	50%	
	Total	53%	
Savings (%)	Users	2,70%	
	Non Users	4,30%	

Figure 4-63: Percentage of savings (+ values) related to the surface of the dwelling, for users and non-users



4.4.3 Results of tenant survey analysis

In Frankfurt two tenant surveys have been carried out – the baseline survey in November 2011 and the final survey at the end of the reporting period in December 2012. The surveys have been realised with face-to-face interviews and telephone interviews. In total, 67 tenants (28% of the total pilot sample) participated in at least one stage of the survey – 57 in the baseline survey, 13 in the final survey. Thereof only three tenants participated in both stages which is a too small number of respondents in order to carry out the originally planned before-after comparison. However, the survey responses allow several analyses of reported behaviour patterns in the baseline survey and the like which are reported in the following.

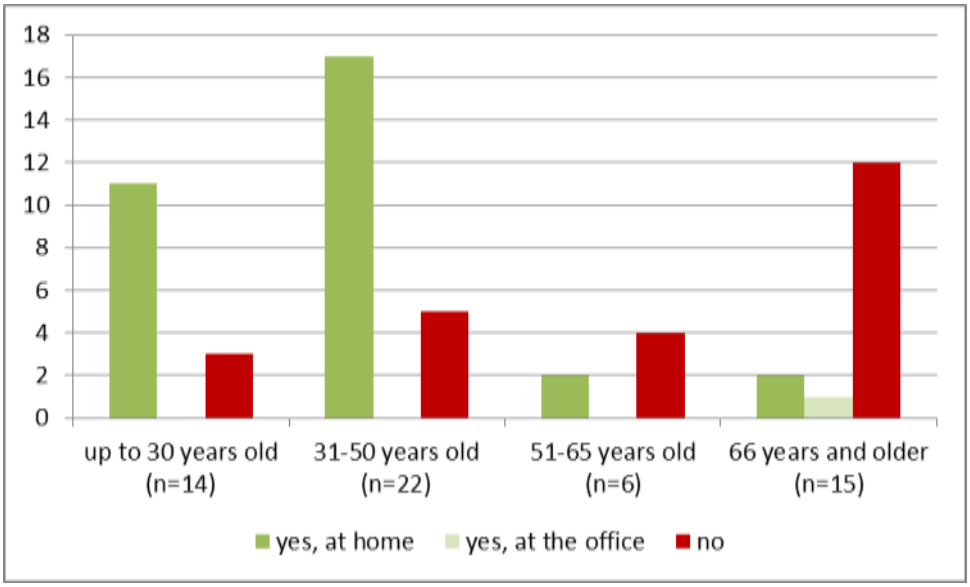
The baseline survey contained socio-demographic characteristics as sex, age, country of birth and income as well as questions regarding reported ventilation behaviour, attendance at home, internet access, temperature settings in the living room, everyday energy consumption behaviour patterns and interest in energy consumption, energy costs, the tenant portal and preferred medium for information.

The final survey asked for the usability of the tenant portal addressed to the EAS users and the usefulness of information provided with the service and the personally best frequency of consumption data updates addressed to the current EAS non-users.

In addition to that it was possible to a limited extent to realise a user/non-user comparison with the baseline survey data, even though it has to be considered that the small number of users (14 tenants) does not allow statistical tests of significance. The number of non-users in the baseline sample was 43 tenants. In the final survey were 5 users and 8 non-users.

An explanation for the comparably larger number of non-users is the finding that 42% of the baseline survey respondents do not have an internet access at home. Thereof 50% belong to the age group 66 years and more.

Figure 4-64: Availability of an internet access by age groups (absolute number of baseline survey respondents)



Among the baseline sample were 39 women (68%) and 18 men (32%). 26% of the respondents of the baseline survey have a migrant background, most of them are Turkish (53%). 39% (n = 22) of the interviewees belong to the age group 31-50 years old, 37% were older than 50 years.

Interest in energy saving and knowledge

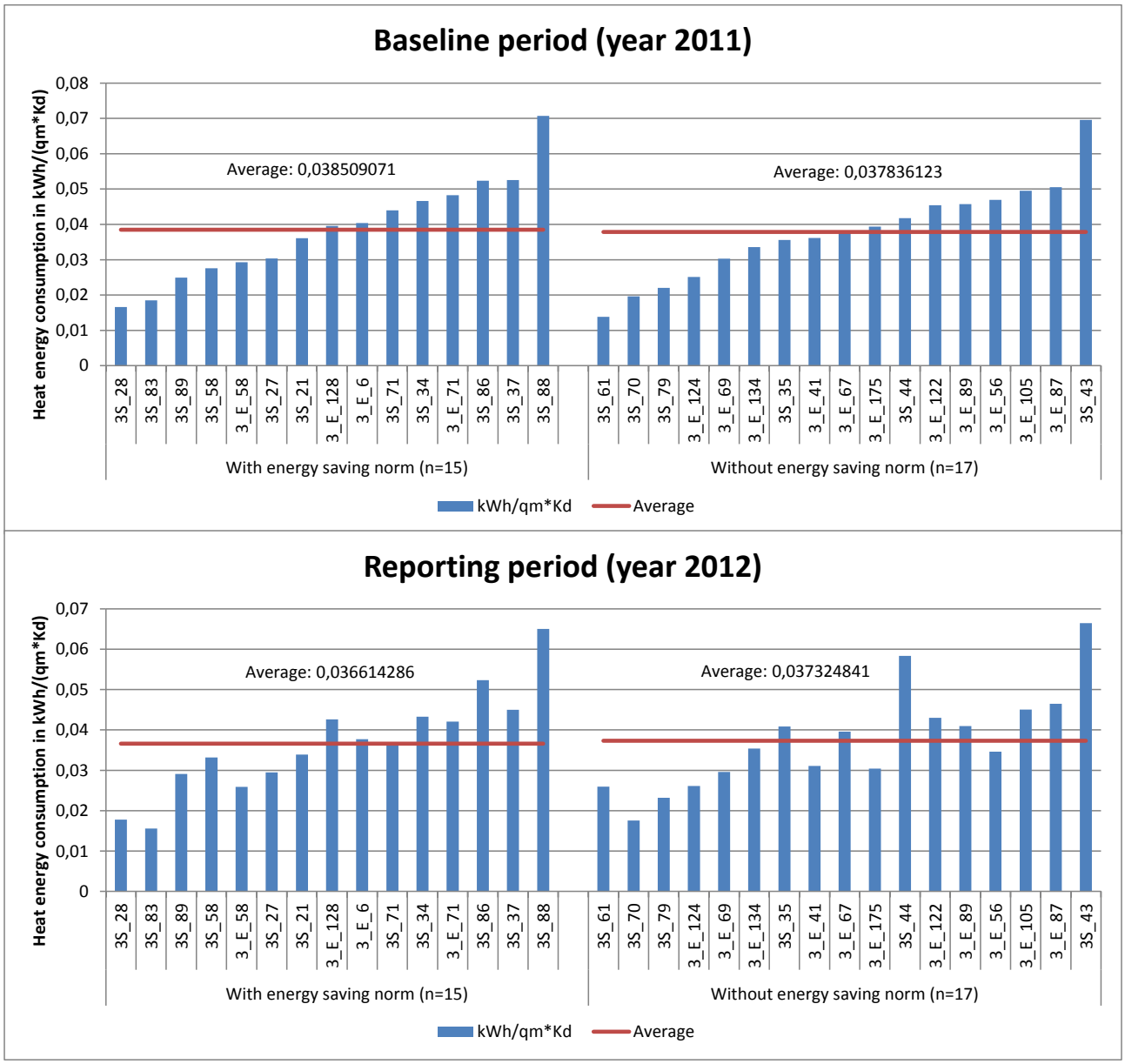
Later EAS users reported in the baseline survey with a higher percentage that they are interested in the possibilities of saving energy at home than current non-users. In parallel, both groups agreed on a lower level that they think they should save more energy at home. That underlies the above statement that the Frankfurt pilot tenants have lower energy bills than the German average. 45% of the later EAS users and 60% of the non-users reported in the baseline survey to be not sufficiently informed about their energy consumption at home.

Table 4-27: Interest in energy saving by current EAS users and non-users (reported in baseline survey, in %)

Aspects	value labels	User	Non-user
I think I should save more energy at home. (n = 11resp. 38)	yes, absolutely	18.2	23.7
	rather yes	27.3	28.9
	rather no	36.4	26.3
	no	18.2	21.1
Regarding my energy consumption I am well informed (n = 11 resp. 38)	yes, absolutely	27.3	18.4
	rather yes	27.3	21.1
	rather no	27.3	36.8
	no	18.2	23.7
I'm interested in possibilities of saving energy at home (n = 12 resp. 35)	yes, absolutely	58.3	37.1
	rather yes	25.0	37.1
	rather no	8.3	17.1
	no	8.3	8.6

The subjective energy-saving-norm (I think I should save more energy at home.) can be treated as the main driver of the individual willingness to save energy. As the following figure shows achieved those tenants who reported in the baseline survey that they absolutely or rather think that they should save more energy with 5 % savings in the pre-post comparison a higher saving result than those tenants without a reported energy-saving norm (1% savings).

Figure 4-65: Pre-post comparison of heat consumption figures (kWh/m^2*HDD) of respondents with and without an energy-saving norm (reported in baseline survey)



Later EAS users more often wanted to learn more about their energy costs and current energy consumption at home – also in combination with reference values compared to the neighbourhood average and compared to historical consumption data (see Table 4-28). It is to assume, that this describes the motivation for using EAS in contrast to the non-users.

That corresponds to the further finding that 57 % of the later users already announced their interest in the eSESH service in the baseline survey. Further 14 % were still undecided at that point of time. In contrast to that, 60% of the non-users were not interested. The same applies to the interest in a regular email with additional information on energy consumption: 67% of the later EAS users were interested, 70% of the non-users weren't. Conversely, 70% of the non-users were interested in a newsletter with information about energy consumption aspects. Users agreed to that to 31%

only. One explanation for that result could be that the non-users have more privacy concerns regarding the use of their private data in a tenant portal or in an email which is not applicable for a newsletter which provides general information only.

45% of later EAS users were interested in energy consumption feedback on a quarter-annual basis, 27% on a semi-annual basis. Only 9% wished to have monthly data as later provided.

Table 4-28: Interest in the main information aspects of EAS

Aspects	value labels	User	Non-user
I want to learn more about my current energy consumption. (n = 12 resp. 34)	useful	83.3	55.9
	rather useful	8.3	20.6
	rather useless	-	11.8
	useless	8.3	11.8
I want to learn more about my energy consumption in comparison with my neighbourhood. (n = 12 resp. 35)	useful	50.0	25.7
	rather useful	25.0	17.1
	rather useless	16.7	22.9
	useless	8.3	34.3
I want to learn more about my current energy consumption in comparison with my energy consumption in previous years. (n = 12 resp. 32)	useful	58.3	53.1
	rather useful	16.7	9.4
	rather useless	8.3	18.8
	useless	16.7	18.8
I want to learn more about my energy costs. (n = 12 resp. 32)	useful	91.7	62.5
	rather useful	8.3	15.6
	rather useless	-	9.4
	useless	-	12.5

Energy consumption behaviour

The heating losses in winter or on colder days caused by ventilation behaviour are always then notably high when tenants leave the windows ajar for a longer time period. The percentage of respondents who ventilate their rooms in that way lay between 18% and 24% which differs in relation to the room use. Conversely, between 52 % and 62 % already follow the most efficient way of ventilating the dwelling by opening the windows widely at times.

Table 4-29: Ventilation behaviour in winter or on colder days related to different room use reported in the baseline tenant survey

	Differentiated by room use				
Ventilation	**Living room**	**Bedroom**	**Other room**	**Kitchen**	**Bathroom**
I open the windows widely at times	62.5	59.3	55.6	55.6	51.9
I leave the windows ajar at times	14.3	13.0	18.9	20.4	18.5
I leave the windows ajar often or all the times	17.9	24.1	20.9	20.4	23.1
I do not open the windows	-	-	-	-	1.9
I don't know	5.5	5.4	4.6	3.7	3.7

The reported ventilation behaviour of EAS users was more energy efficient than that of non-users. Users preferred more often to ventilate their rooms by opening the windows widely at times than non-users (71% compared to 54%). In addition to that, the from the users reported average temperature in the living room in winter was with 20.6 °C lower than that of the non-users with on average 21.7°C.

As shown in Table 4-30, the heating and hot water consumption behaviour of later users and non-users in the baseline survey were very similar and already predominantly energy conscious (except cold water use for hand-washing).

Table 4-30: Typical aspect of heating and hot water consumption behaviour by current EAS users and non-users (related to the baseline survey, in %)

Aspects	value labels	User	Non-user
Do you turn off the heating/the radiator when you open the window? (n = 14 resp. 40)	yes	80.0	78.6
	no	17.5	21.4
	don't know	2.5	-
Do you turn the heating down when you leave your home for a longer time? (n = 14 resp. 38)	yes	76.3	78.6
	no	21.1	14.3
	don't know	2.6	7.1
Do you rather take a shower instead of a bath? (n = 12 resp. 30)	yes	93.3	83.3
	no	3.3	16.7
	don't know	3.3	-
Do you use cold water to wash your hands? (n = 10 resp. 29)	yes	27.6	50.0
	no	62.1	50.0

	don't know	10.3	-

Satisfaction with EAS

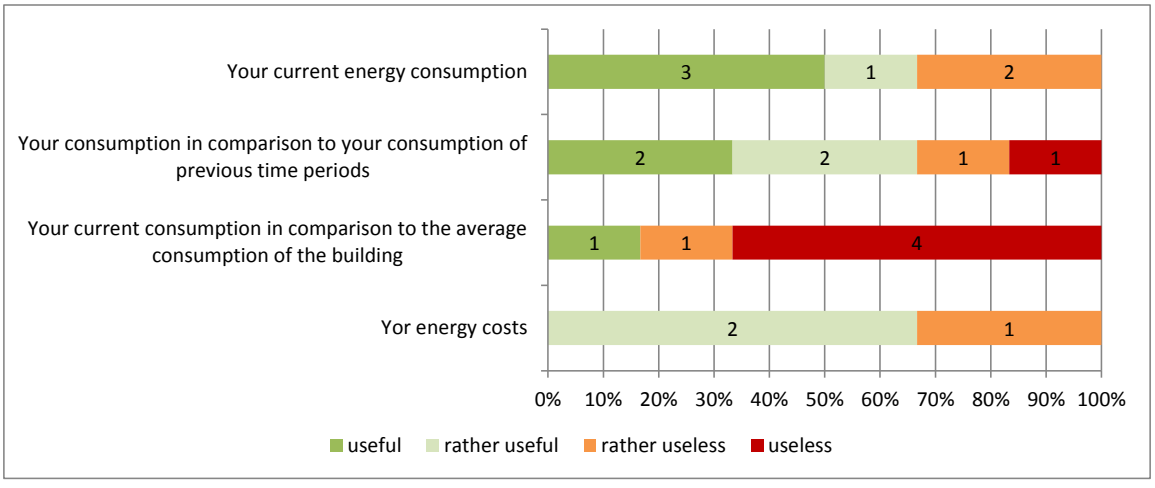
The final survey contained questions regarding the usability and the functionality of the EAS tenant portal which were addressed to the current EAS users. As above mentioned the willingness to participate in the final survey was low. In total only 13 tenants participated. Thereof 5 respondents were current EAS users. Their satisfaction with the portal was a follows:

- 4 of the 5 EAS users assessed the log-in procedure as satisfactorily, the remaining person saw potential for optimisation.
- 3 users could handle the navigation without problems. The remaining 2 users didn't response.
- 4 of 5 users accept the visualisation of the consumption figures. One tenant was not satisfied.
- 3 users were satisfied with the further explanations and descriptions of consumption data presentation. One tenant stated a demand for improvements. One person didn't answer.
- 2 users assessed the benchmarking/reference values as useful. The remaining three respondents didn't respond.

Interest of non-users in information provided by EAS

As already stated in the baseline survey, parts of non-users are also interested in EAS components – especially in feedback of current consumption figures and historical comparisons. Nevertheless, only one non-users articulated deeper interest in the EAS usage. The remaining non-users (n=8) were still undecided. That suggests that these tenants probably could be activated with other instruments than a web portal.

Figure 4-66: Interest of current EAS non-users in information provided by the eSESH service (How useful would be…?)

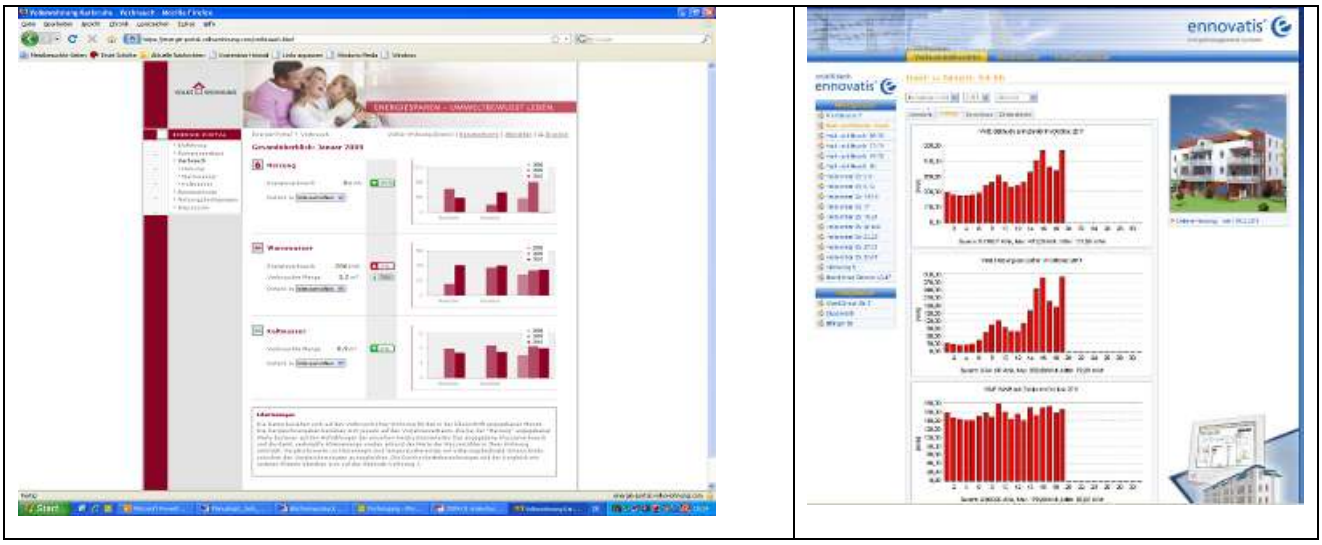


4.5 Karlsruhe

4.5.1 Background information

The eSESH EAS is directed to the tenants with the purpose to raise consciousness concerning energy saving potentials in their homes. Using the energy portal, the tenants in Rintheim can check and control their energy consumption. This includes heating energy and hot and cold water consumption on a monthly basis and several reference values as previous consumption figures, average consumption related to all dwellings in the building and related to the whole comparable tenant households. The planned relaunch of the service including a feedback on electricity consumption on an hourly basis could not be realised in the project due to a change of the ERP-system in 2011 and the billing system in 2012. The Energy portal uses the databases of these systems and could not work with the new software. Karlsruhe had to develop a new version of the energy portal, but due to personnel changes the service could not be finalized in time.

Figure 4-67: Screen shots of the EAS tenant portal (left) and the EMS staff portal (right)



Within the eSESH project the Karlsruhe pilot site concentrated special effort on Energy Management services which started in September 2010. The EMS is directed towards monitoring and controlling the heat supply systems in Volkswohnung's (VoWo) building stock. VoWo is in charge of the management of about 30 buildings in the residential quarter Karlsruhe-Rintheim. Since September 2009 sixteen of these buildings have been connected to a district heating network. At this site flat-plate solar panels on the top of the building support the domestic hot water production in addition to the district heating supply. The main aim of the EMS is to ensure early fault detection and the improvement of the performance of the heat supply system. A bad performance leads to higher consumption and to higher energy costs for tenants. By implementing a monitoring system it is possible to identify those systems which have unsatisfactory energy performance and to take early actions to improve them. Therefore the intention of EMS was to control heat supply system performance and to trigger counteraction if system degradation is observed. The pilot operation shows that EMS services is a useful instrument to help staff members who are confronted with tenant's complaints and problems from inefficient heating

system. As a management and control system it could also prevent a part of tenant's reclaims and technical problems.

The first tenant information by letter with access data for the energy portal (heating only) has been carried out in September 2010. Referring to this first contact with the tenants (via letter) there was low interest of pilot tenants of using the service. From nearly 600 contacted tenants only 27 accessed to the portal.

Further tenant correspondence and meetings were planned when providing EAS including electricity consumption data in addition to heating and hot water. Due to the above described delay these tenant events had to be postponed. Once the relaunch of the EAS is possible all tenants of the pilot site will be invited again to a tenant event. The intention of this event is to introduce the system and to present the functions and advantages of EAS to the tenants. First active work with the system will be shown and positive results from already known users can be used as motivation. After this marketing event tenants can also call for a face2face meeting. The tenant's data will be analysed and discussed. As a result tenants will receive personal tips how to reduce energy and water consumption. VoWo/SWK can also initiate a face2face meeting to motivate tenants to use the service regularly and/or to support them in changing their consumption behaviour and reducing energy costs.

Training sessions for staff regarding EAS (heating) have been done before the installation of the service in September 2010.

In total, 533 pilot dwellings located in 17 buildings were involved in the pilot. Due to the above described still outstanding relaunch of the EAS service, the number of current users is low (n=27).

Table 4-31: Overview of the number of buildings and dwellings involved in the Karlsruhe pilot

Site	Pilot site name	Number of buildings involved	Number of dwellings involved
Karlsruhe	Rintheim	17	533

4.5.2 Results of consumption data analysis

Related to heating and water (hot and cold) in Karlsruhe 473 dwellings have been equipped with the eSESH service. Before analysing the data, it was necessary to cleanse it in order to take into account the change of tenancy as well as some incoherencies or periods of absence of the tenants. In these cases, these dwellings were excluded from the analysis. The dataset analysed represents nearly 70% of the whole dataset.

For calculation the savings a pre-post comparison has been used. The analysis is based on the evolution of the consumption figures before and after the implementation of the service. In view of the eSESH service operation start in September 2010, the consumption during the baseline period (01/01/2009 – 31/08/2010) has been compared to the consumption of the reporting period (01/09/2010 – 31/12/2012).

Table 4-32: Description of the cleansing step

Cleansing			
Data	Site	Number of dwellings	
		Before cleansing	After cleansing
Heating	Total	473	323
Hot water	Total	377	260
Cold water	Total	377	255

Global results of heating and water consumption analysis (EAS)

As presented in the table below, savings are calculated for heating as well as for domestic hot water (DHW) and cold water.

Table 4-33: Overview of global results in Karlsruhe

Key data			
	Heating	Hot water	Cold water
Number of dwellings	323	260	255
Surface area (average)	66,4	66,2	66,3
Number of people (average)	-	-	-
Global Results for the dataset of dwellings			
	Heating	Hot water	Cold water
Savings (%)	14,30%	5,60%	2,10%
Saving (kWh/yr or m3/yr) - eeMeasure	203 750	402	317
Carbon Dioxid Reduction in kgCO2/yr - eeMeasure	15 582	-	-
Financial Saving (€/yr) - eeMeasure	10 595	3 212	635
Consumption Before Intervention (kWh/yr)	1 417 891	7 004	15 000
Results (per dwelling, per people or per m²)			
	Heating	Hot water	Cold water
Consumption Unit	*(kWh/m².year)*	*(kWh/m².year)*	*(kWh/m².year)*
Consumption - Before intervention	63	0,41	0,89
Consumption - After intervention	57	0,39	0,87
Consumption Unit	*(kWh/dm².year)*	*(kWh/dwelling.year)*	*(kWh/dwelling.year)*
Consumption - Before intervention	63	27	59
Consumption - In the same country*	162*	92 (for a dwelling of 2 people)	
Saving (kWh/dwelling.yr or m3/dwelling.yr)	631	2	1
Carbon Dioxid Reduction in kgCO2/dwelling.yr	48	-	-
Financial Saving (€/dwelling.yr)	33	12	2
** See references*			

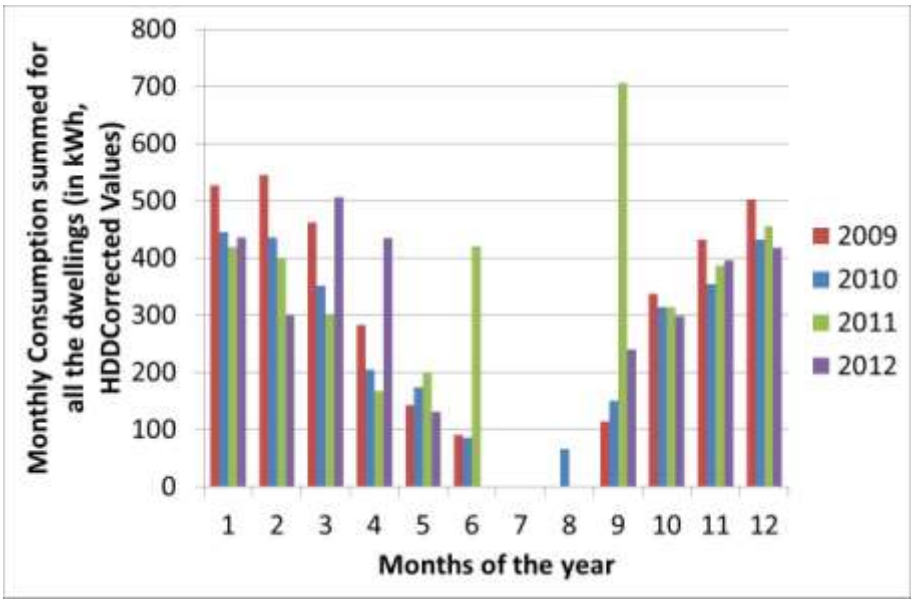
The global calculation of savings following a pre-post comparison led to the results shown in the above table. Therefore global savings of about 14% heating, 6% DHW and 2% cold water have been calculated.

Compared to the savings target for heating and hot water of at least 10% up to 25% (described in the evaluation planning deliverable D7.1) the heating savings can be assessed as success. But also the water savings look promising.

Heating

The graph below shows the evolution of the heating consumptions from 2009 to 2012. The analysis of the year 2010 was complex because the service was implemented in the middle of the year. That's why, in order to carry out correct analysis, the calculation of savings is based on the comparison between the year 2009 for the baseline and the years 2011 and 2012 for the reporting period.

Figure 4-68: Comparison of the monthly consumptions (summed for all the dwellings) for the years 2009, 2010, 2011 and 2012



For heating, it is important to compare the levels of annual consumption per m². The graphs below highlight a tendency of tenants in small dwellings to consume energy more than those in large-sized dwellings. The comparison of these two charts, corresponding to the years 2009 and 2012, shows a global decrease of the heating consumptions.

Figure 4-69: Annual Heating Consumption (in kWh/m²) related to the surface of the dwelling in m², in 2009

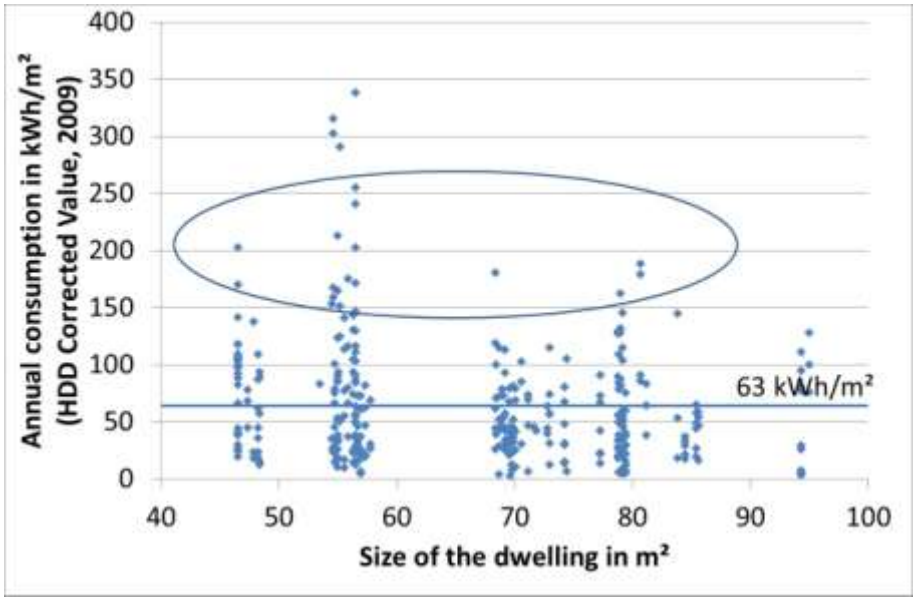
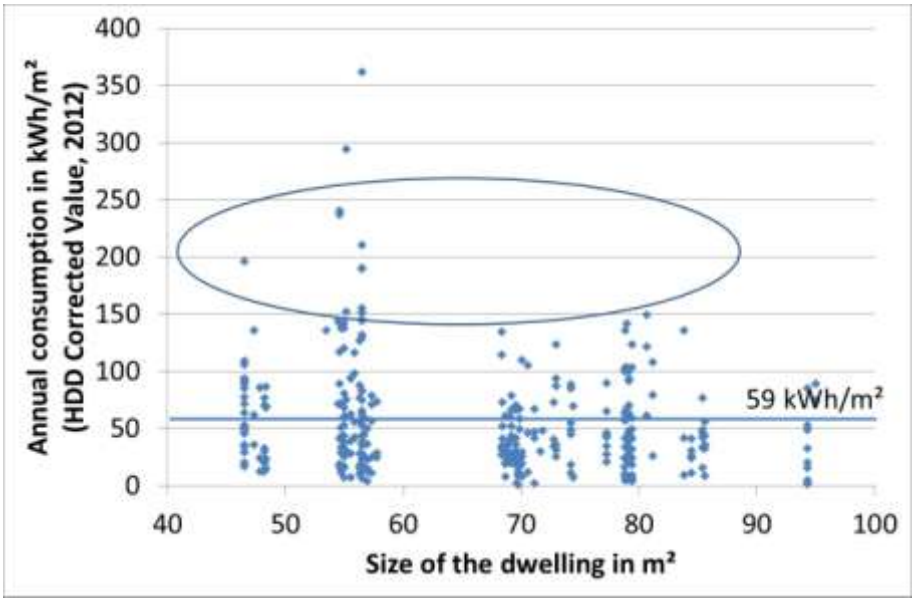


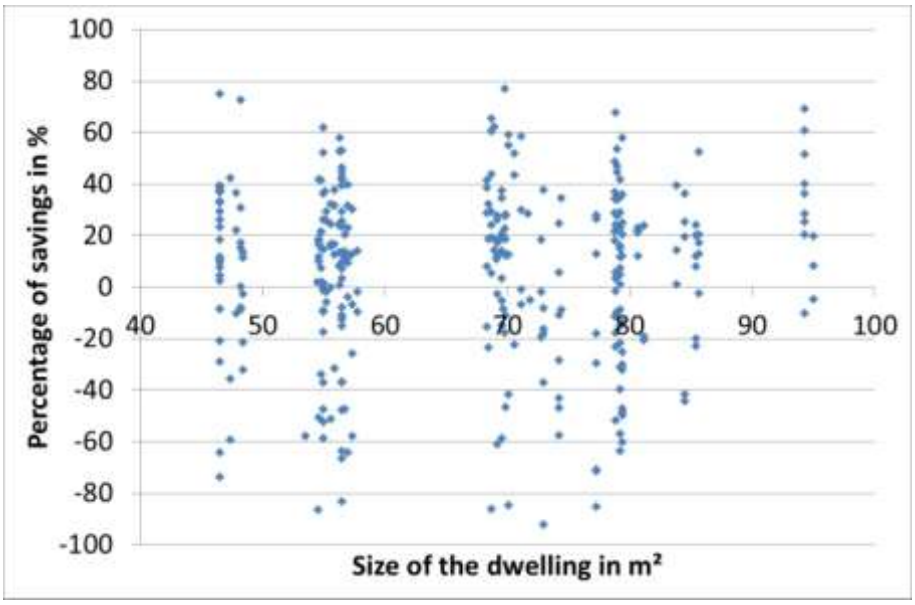
Figure 4-70: Annual Heating Consumption (in kWh/m²) related to the surface of the dwelling in m², in 2012



It was further interesting to study the relation between the percentage of savings and the size of the dwellings.

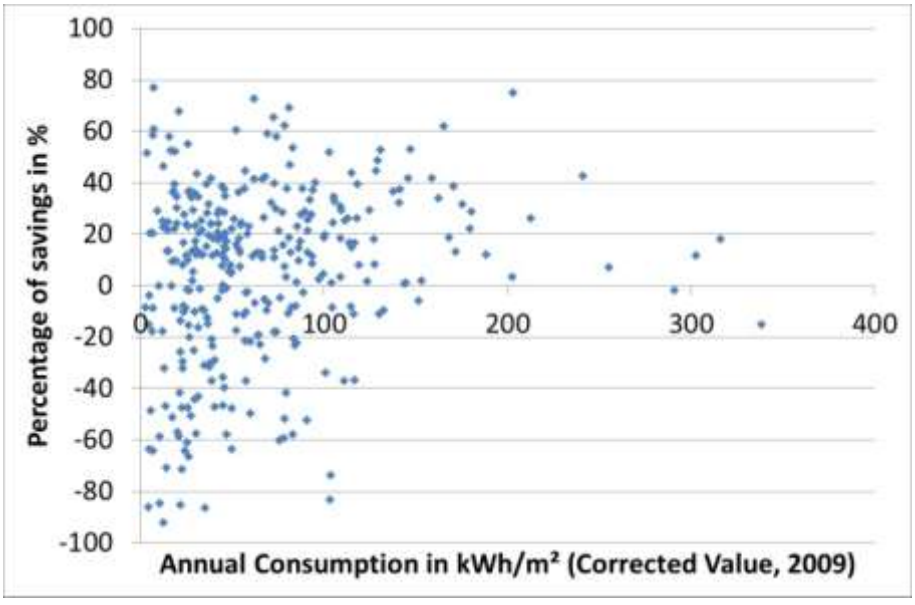
The chart below shows that a majority of the tenant households (63%) achieved savings. in addition to that it became obvious that there is no correlation between the size of the dwelling and the tendency to make savings.

Figure 4-71: Percentage of savings (+ values) related to the surface of the dwelling in m²



In the following figure the surface of the dwelling has been replaced by the annual consumption of the baseline period.

Figure 4-72: Percentage of savings (+ values) related to annual consumption in kWh/m²



Lastly, it was of interest to compare the level of consumption of the pilot tenants with the national level of consumption. In Germany, the average annual heating consumption equals 162kWh/m². For the dataset of dwellings analysed in Karlsruhe an average consumption of 63kWh/m² has been calculated. Thus, the pilot tenants already consume less than the national average and as a consequence, they are limited in terms of feasible savings. As a consequence, the savings that were calculated are a very good result.

Domestic hot water (DHW)

The two charts below present the annual hot water consumption (in m3/m²) related to the surface of the dwelling for the two years 2009 and 2012. From these graphs it can be observed that there is again no correlation between the size of the dwelling and the annual hot water consumption. The level of consumption is quite the same for small dwellings and large-sized dwellings. But, it can be asserted that the high consumers seem to have made effort.

Figure 4-73: Annual hot water consumption (in m3/m²) related to the surface of the dwelling in m², in 2009

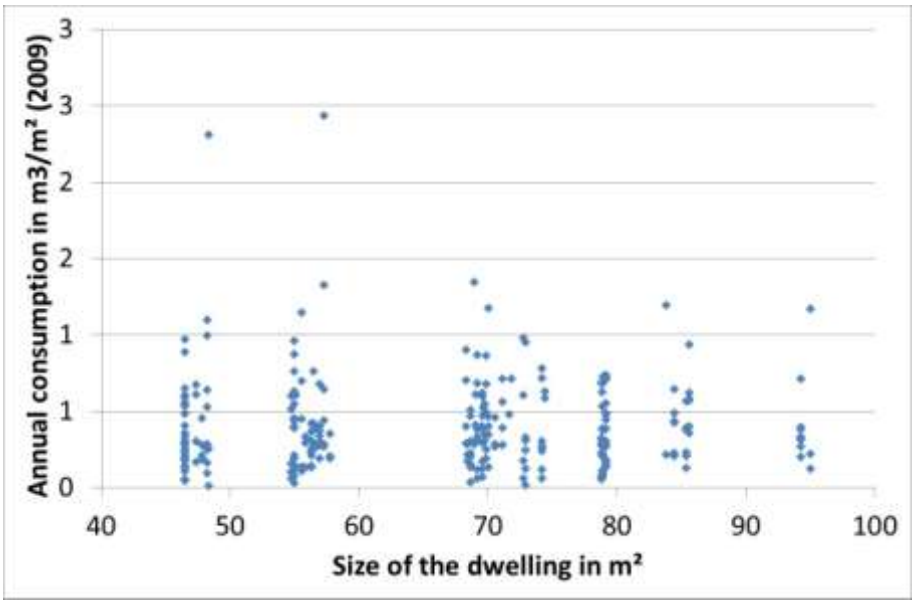
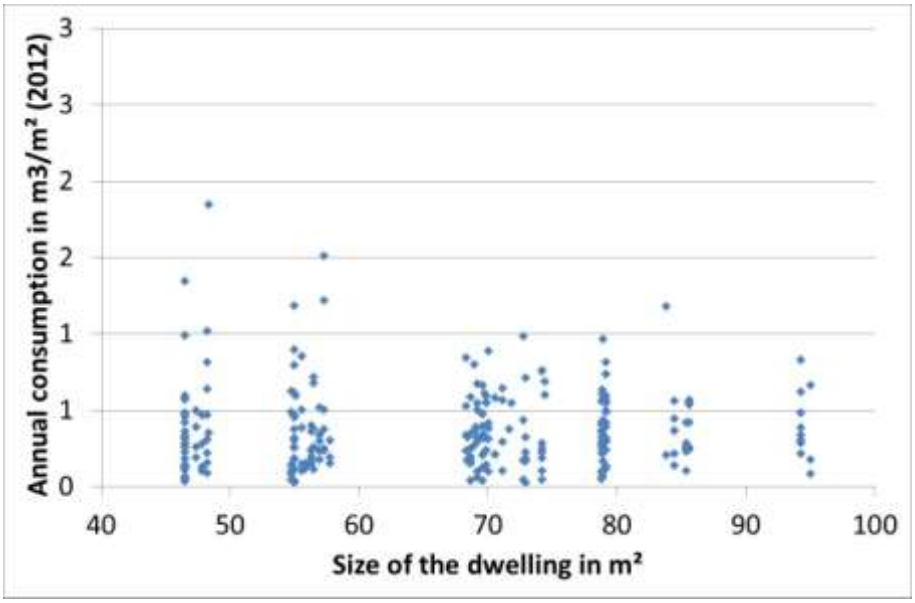


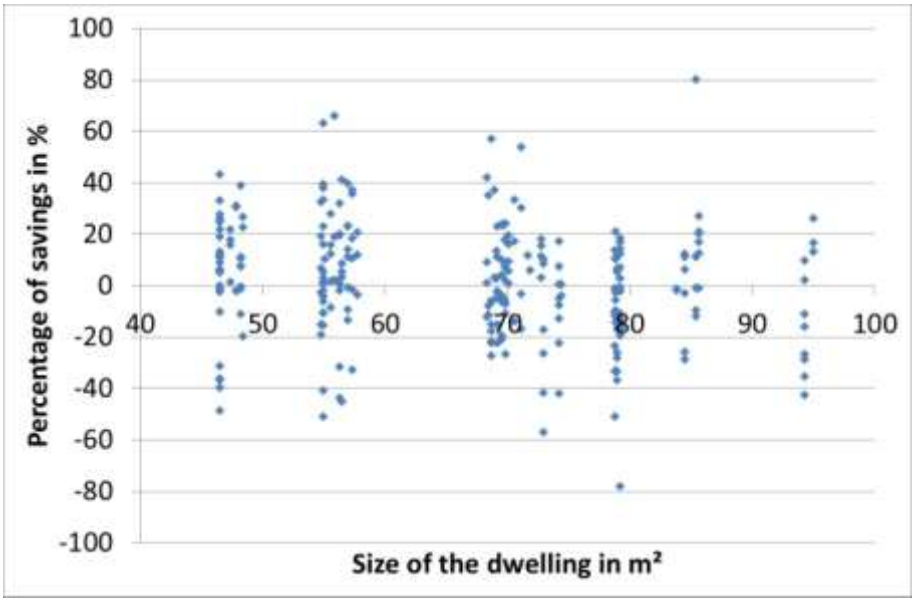
Figure 4-74: Annual hot water consumption (in m3/m²) related to the surface of the dwelling in m², in 2012



Again it was interesting to study the relation between the percentage of savings and the size of the dwelling. As the following figure shows, 55% of the tenants achieved savings. In addition to that the

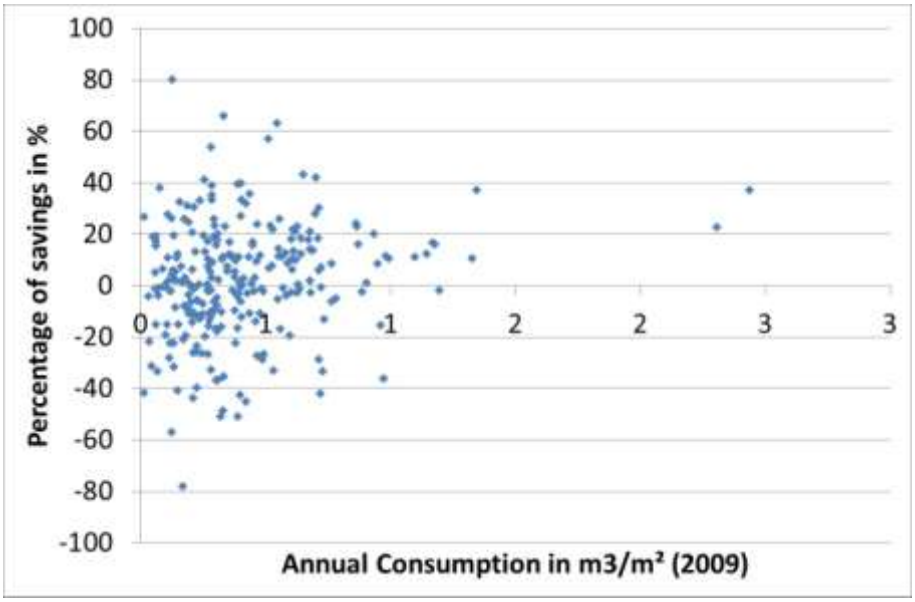
graph highlights a tendency from tenants in small dwellings to make more savings than those living in the large-sized dwellings.

Figure 4-75: Percentage of savings (in %) related to the surface of the dwelling in m²



In the following figure the surface of the dwelling has been replaced by the annual consumption of the baseline period.

Figure 4-76: Percentage of savings (in %) related to annual consumption in kWh/m²



Cold Water

The same conclusions as for hot water can be applied to cold water. Nevertheless, the two following charts show that the decrease of the consumptions is less important for cold water.

Figure 4-77: Annual cold water consumption (in m3/m²) related to the surface of the dwelling in m², in 2009

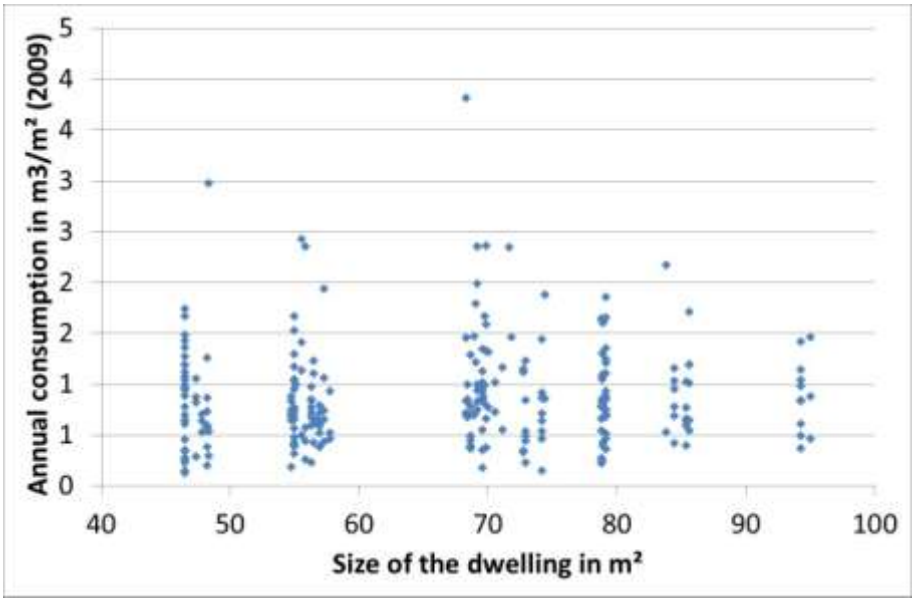
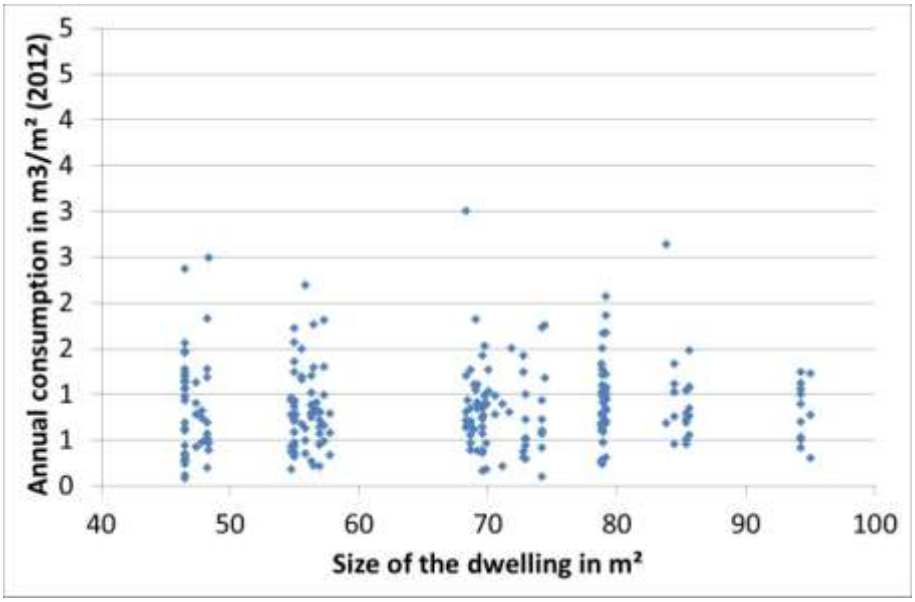
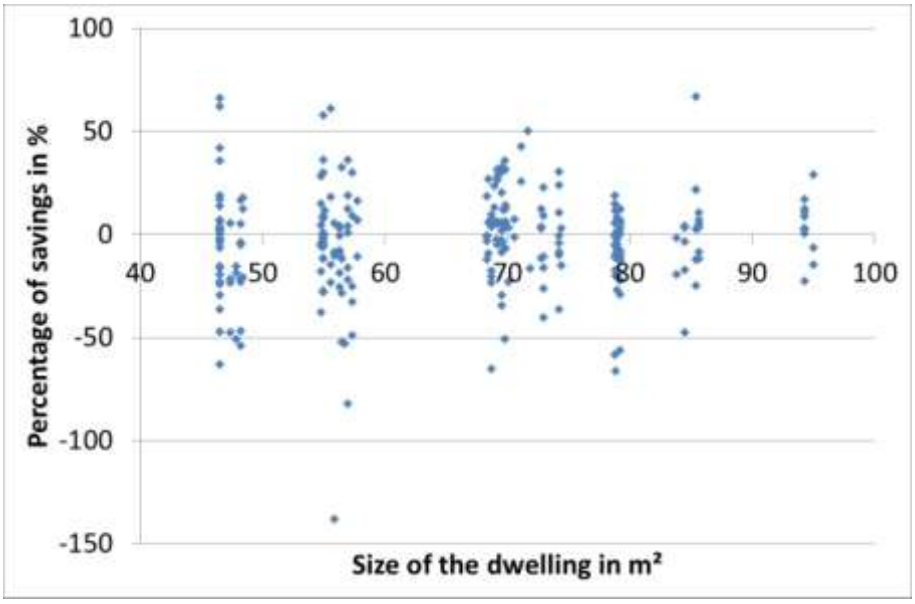


Figure 4-78: Annual cold water consumption (in m3/m²) related to the surface of the dwelling in m², in 2012



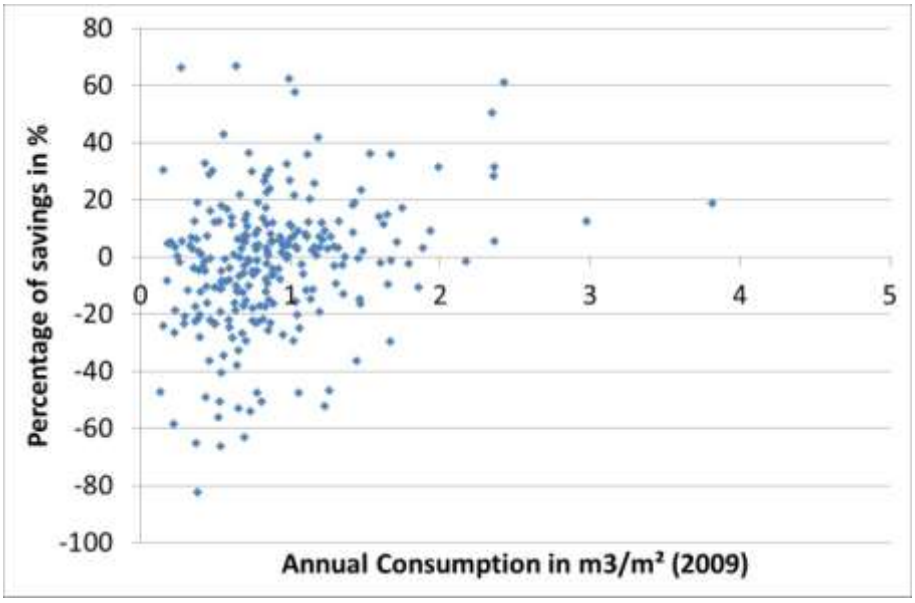
The analysis of the relation between the percentage of savings and the size of the dwelling in the following chart shows that half of the tenants (50%) achieved savings.

Figure 4-79: Percentage of savings (+ values) related to the surface of the dwelling in m²



After replacing the dwelling size by the annual consumption of the baseline period the graph shows no correlation between the type of consumer (high or low) and the capacity or the motivation to make savings. Savings have been achieved by all types of consumers.

Figure 4-80: Percentage of savings (+ values) related to annual consumption in m3/m²



Comparison between users and non-users of the eSESH service

As explained above, in Karlsruhe currently only a small number of tenants make use of the service. Therefore only 8 users could be included in the following analysis which allows a restricted interpretation only. Nevertheless, the results of the following table show a positive tendency. It could be observed that the service seems to have a very different impact on heating consumption of users who made on average 27.5% savings. Not as good the results are for hot water and cold

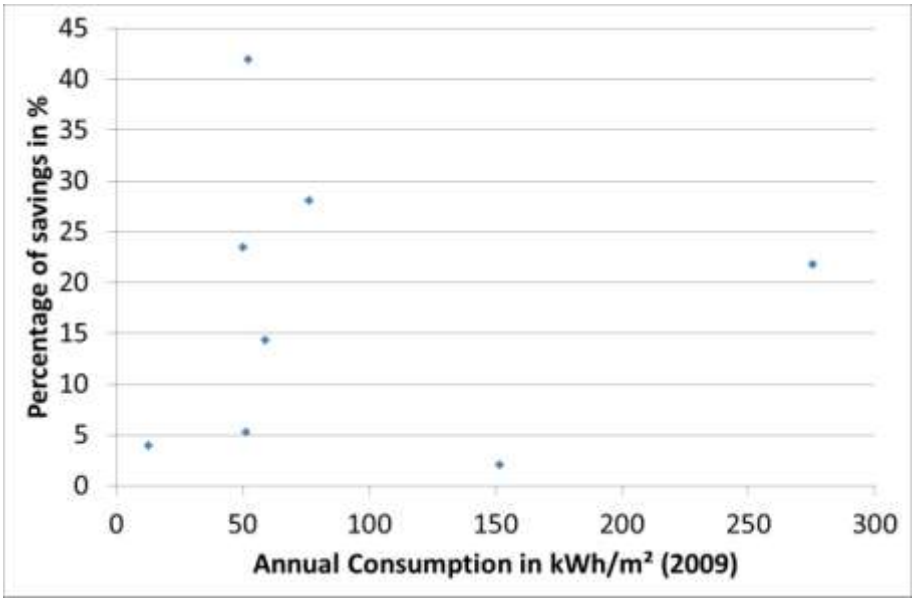
water. This observation can be related to the level of consumption of the users. In the case of heating it is to be seen that users had a higher level of consumptions than the whole pilot sample. As a consequence, it might be easier for them to improve their behaviour significantly.

Table 4-34: Distribution of users and non-users in the consumption dataset & Results

Comparison between users and non-users							
		Heating		Hot water		Cold water	
Total of dwellings	Users	8	2%	6	2%	6	2%
	Non Users	315	98%	254	98%	249	98%
	Total	323	100%	260	100%	255	100%
Surface per dwelling	Users	62,45		64,59		64,59	
	Non Users	66,45		66,25		66,34	
People per dwelling	Users	-		-		-	
	Non Users	-		-		-	
Average Annual Consumption 2011 (baseline period)	*Unit*	*kWh/(m².year) in 2011*		*kWh/(dw.year) in 2011*		*kWh/(dw.year) in 2011*	
	Users	72		0,34		0,86	
	Non Users	59		0,39		0,87	
% of dwellings which made savings	Users	100%		50%		33%	
	Non Users	63%		55%		50%	
	Total	63%		55%		50%	
Savings (%)	Users	27,50%		1,10%		1,60%	
	Non Users	-		-		-	

The figure below shows the percentage of savings related to the annual heating consumption before the implementation of the service. It shows that all the users made savings – the high consumers as well as the low consumers.

Figure 4-81: Percentage of savings (in %) related to annual heating consumption in kWh/m²



Global results of consumption data analysis (EMS)

As said in the introduction of this section dedicated to Karlsruhe, the planned Energy Management System is directed towards monitoring and controlling of the heat supply systems in Volkswohnung's building stock. VoWo is in charge of the management of about 30 buildings in the residential quarter Karlsruhe-Rintheim. Since September 2009, sixteen of these buildings have been connected to a district heating network. At this site, flat-plate solar panels on the top of the building support the domestic hot water production in addition to the district heating supply.

The main aim of the EMS is to ensure early fault detection and the improvement of the performance of the heat supply system. A bad performance leads to higher consumption and to higher energy costs for tenants. By implementing a monitoring system, it is possible to identify those systems which have unsatisfactory energy performance and to take early actions to improve them. Therefore the intention of EMS was to control heat supply system performance and to trigger counteraction if system degradation is observed. The EMS service was implemented in September 2010 for 8 buildings and in March 2011 for 9 buildings. Moreover, these buildings were refurbished in 2010 and 2011. Considering this, it is not possible to realize a pre-post comparison as the baseline period cannot be compared to the reporting period. Nevertheless, the pilot operation shows that EMS services is a useful instrument to help staff members who are confronted with tenant's complaints and problems from inefficient heating system. As a management and control system it could also prevent a part of tenant's reclaims and technical problems.

4.5.3 Results of tenant survey analysis

In Karlsruhe one tenant survey has been carried out in the baseline period in October 2011. In total 26 households (4.7% of the total pilot sample of 533 pilot tenants) participated in. The survey data collection was made directly during "Tenant Service" service hours when tenants came there with concerns and questions. Due to data protection issues the Karlsruhe pilot site that's why decided to carry out a fully anonymous survey. That means that they didn't make use of the tenant ID approach. As a consequence links between tenant's consumption figures, EAS use and – for example – the reported energy consumption behaviour patterns are not possible.

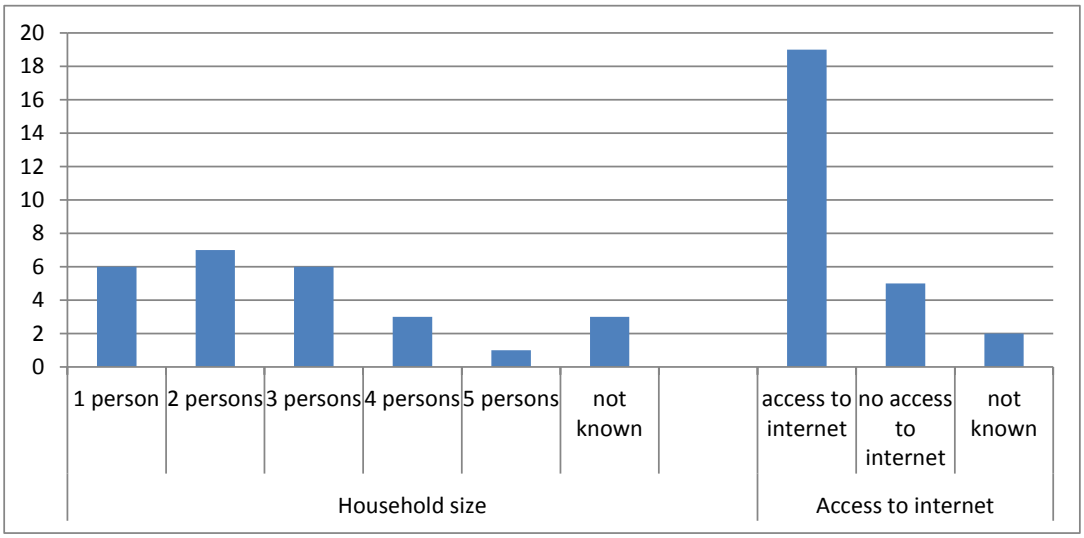
The baseline survey focussed on attitudes towards energy saving, energy consumption behaviour and knowledge about energy consumption issues.

Due to the above described, still not realised relaunch of the EAS tenant portal including also electricity data and due to a currently low number of users the scheduled final survey was postponed to a later time period (after the eSESH project). The EAS relaunch shall come along with attractive new features, so that the Karlsruhe pilot site expects both higher interest in using the tenant portal and an increased willingness to participate in a tenant survey focussing on the acceptance with the eSESH service.

In the baseline survey participated in 21 women and 2 men. In two cases the sex is not known, in one case a woman and a man filled out the questionnaire together. The oldest person in the sample was 67 years old and the youngest 24 years old. On average the respondents are nearly 46 years old. Most of the respondents live in single- and two-person-households (In total there were living 55 people in 23 households. Three responses were missing).

In total 19 respondents have an internet access (17 at home, 1 via smart phone, 1 in the office).

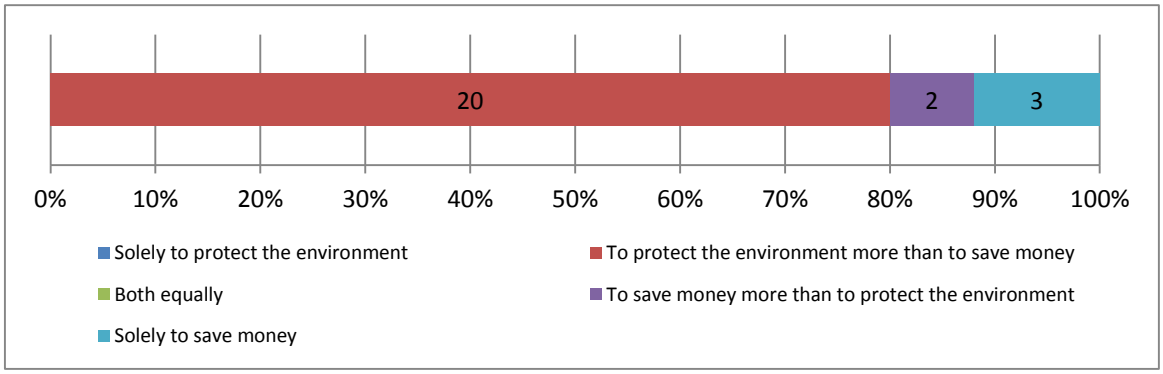
Figure 4-82: Household size and available internet access (total number of respondents)



Attitudes toward energy savings

25 of the 26 respondents are aware that energy saving is necessary (n=22) or fairly necessary (n=3). The motivation to save energy is high and more often caused by environmental protection issues than by saving money.

Figure 4-83: Motivation to save energy



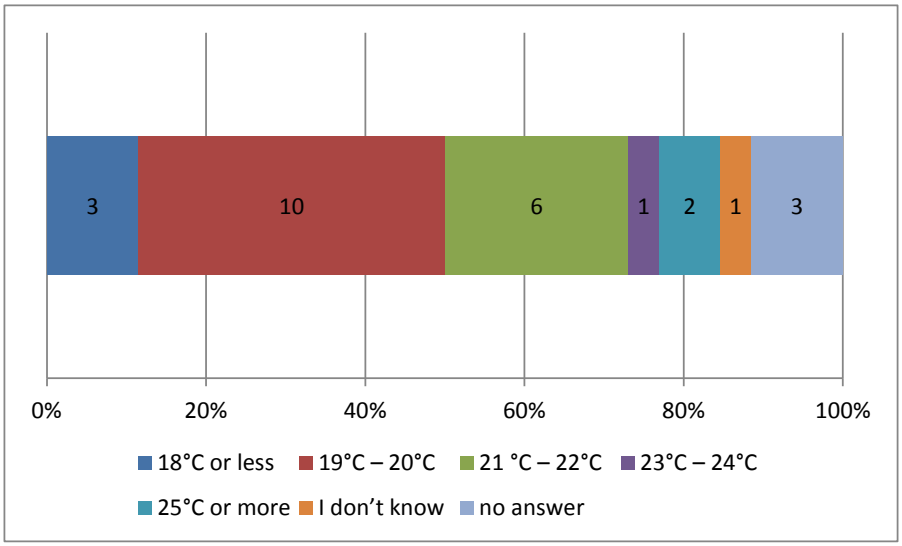
8 of the 26 respondents assumed to belong to the group of very high resp. high consumers. 16 respondents assessed their own energy consumption as medium, one as low.

Temperature setting in winter and reported energy consumption behaviour

For 17 respondents the room temperature is easy to regulate. 5 persons reported on some difficulties, two persons assessed that it is impossible for them to regulate the room temperature by themselves.

The reported room temperatures had a range from 18°C to 25°C with a mean value of 20.4°C. As the following figures shows half of the respondents reported on already optimal indoor temperatures of maximal 20 °C. Two thirds of the respondents feel comfortable with their winter room temperatures. For seven respondents the indoor temperature is too warm..

Figure 4-84: Reported room temperature in winter



According to that, the heat energy consumption behaviour is very energy-conscious. Most of the respondents reported on low thermostat settings especially at nights. In each case only one respondent reported on maximum settings in the living room and in the bathroom.

Table 4-35: Reported thermostatic valve settings related to room use and time of day (percentages)

Room	Off	I (Minimum)	II	III (Medium)	IV	V (Maximum)
Daytime						
Living room (n = 23)	26.1	26.1	8.7	30.4	-	4.3
Bedroom (n = 21)	61.9	33.3	-	3.8	-	-
Kitchen (n = 23)	69.6	17.4	4.3	8.7	-	-
Bathroom (n = 21)	57.1	9.5	9.5	19.0		4.8
Other room (n = 17)	58.8	5.9	11.8	23.5	-	-
Night time						
Living room (n = 24)	45.8	37.5	4.2	12.5	-	-
Bedroom (n = 20)	75.0	10.0	10.0	5.0	-	-
Kitchen (n = 23)	65.2	17.4	4.3	13.0	-	-
Bathroom (n = 20)	65.0	25.0	10.0	-	-	-
Other room (n = 17)	58.8	17.6	5.9	17.6	-	-

This already shown heat energy awareness matches with the results of the following table:

- The predominantly majority of respondents turn the heating down or off when a room is unused, when no one is at home for a longer time period and when opening the windows.
- At night the room temperatures is usually low.
- In winter time most of the respondents keep in mind to shut windows and doors in commonly used rooms as stairways, etc.

Table 4-36: Everyday heat energy consumption behaviour

	(Nearly) always/often (in %)
I turn off the heating when opening the windows (n = 24)	87.5
I turn the heating down or off when I leave a room unused (n = 24)	91.7
I turn the heating down when I leave my home for a longer time (n = 26)	88.5
At night the room temperature is usually low (n = 24)	87.5
In winter time I keep in mind to shut windows and doors in commonly used rooms (n = 26)	84.6

Except regarding the use of energy saving bulbs, which is not as popular, most of the tenants also act electricity-conscious: They turn out the light or switch of the TV when no one is in a room, prevent stand-by losses and mind the energy consumption when purchasing new electric appliances.

Table 4-37: Everyday electricity energy consumption behaviour

	(Nearly) always/often (in %)
I switch off TV or other equipment when there is no one in the room for a longer time (n = 26)	92.3
I use energy saving bulbs (n = 25)	64.0
I turn out the light when no one is in the room (n = 24)	100.0
When purchasing new electric appliances I mind their energy consumption (n = 25)	88.0
I switch off an apparatus totally and don't let it in standby-mode (n = 26)	84.6

Regarding hot water consumption nearly three quarters of respondents reported on rather taking a shower instead of a bath.

Table 4-38: Everyday hot water consumption behaviour

	(Nearly) always/often (in %)
I rather take a shower instead of a bath (n = 26)	73,1
I use cold water to wash my hands (n = 26)	61.5

Information demand and preferred information source

14 resp. 15 respondents reported on a good information level related to their electricity consumption resp. heat energy and water consumption. Even though half of the respondents know sources as e.g. governmental organisations which inform about possibilities to save energy, only 7 tenants already used this information source. Two thirds of the respondents were very much or fairly much interested in such kind of information. At the time of the survey tenants received information about their energy consumption predominantly only from their annual bill (85%) which describes a high interest of 88% of the respondents in energy information provided by the housing provider. The preferred information medium for getting this energy information is by brochure (85%), followed by internet (40%) and electronic displays at home (8%).

As the following table shows tenants were especially interested in information about their current energy consumption and in tips for saving heat energy, water and electricity. They were less interested in tips for buying appliances.

Table 4-39: Information demand

Information tenants are especially interested in (n = 25)	Named in %
My current consumption	84.0
The development of my consumption	48.0
My consumption related to the neighbours consumption	48.0
The energy character of my building	48.0
Tips for saving heating energy	68.0
Tips for saving hot water	72.0
Tips for saving electricity	72.0
Tips for buying appliances	12.0

For 92% of the tenants it was likely or rather likely to use the EAS information service of the housing provider.

4.6 Linz

4.6.1 Background information

Within the pilot site in Linz an integrated EAS/EMS-service for tenants is installed as eSESH service. The EAS is based on a tenant web portal providing energy consumption feedback. The EMS which can be used with an iPod application provides in addition to that several possibilities to manage the home energy consumption ('Green Plug'). There are two main differences to be emphasized: The EAS service delivers daily consumption data via the web portal. The EMS service delivers only consumption data from the meters and from the Green Plug. The Green Plug may be placed at any socket with any equipment (e.g. fridge) and may be used as a sub-meter as well as a switch that is controlled by time, by tariff, by exceeding consumption thresholds as well as directly by the user via iPod.

The system does not only provide energy consumption information to the end customer by using a web based information platform but it allows the delivery of real measured data – not only images - to the customers. Web-based information platforms do have the disadvantage that the consumption values will be usually available only the next day. Additionally, those values can be only observed as they cannot be used to control energy management equipment in the tenants flat. Therefore, with the tenant-EMS measurement data is provided to the customer directly by using IP-based communication. This allows tenants not only to check the consumption values in real time but they also can configure some switching and control equipment to react (switch) if a specific tariff is available or if a defined consumption threshold is exceeded.

Figure 4-85: Examples of the tenant EAS web portal EAS and the iPod-EMS

Between February and October 2011 several tenant meetings have been realised. During a first meeting in the context of signing the rental agreement tenants got first information about the project and were asked to participate. Afterwards the "Neighbour Celebration" event and the eSESH Information Day included presentations with real equipment. In addition to that information letters have been sent to the tenants with kick-off-date and web account. Between September

2011 and October 2011 Linz partners also sent information letter to tenants with the starting time, web account and the allocation of user groups. In November 2011 interested tenants were trained.

In addition to that several training sessions with the Linz staff took place between January and September 2011.

As shown in the following table, in total 361 dwellings – all newly constructed – were included in the pilot. Thereof, 34 tenants belong to the EMS group and 48 tenants could make use of the EAS web portal. The remaining tenants belong to the control group.

Table 4-40: Overview of the number of buildings and dwellings involved in the Linz pilot

Site	Pilot site name	Number of buildings involved	Number of dwellings involved
Linz	Laskahofstraße	1	90
	Bäckerfeld	1	59
	Donaupark	3	204
	Riegelstraße	1	8

The EAS pilot operation started in Nov 2011, the EMS pilot operation started in Jan 2012.

4.6.2 Results of consumption data analysis

In the Linz pilot electricity and heating consumption have been measured. Electricity is used for different domestic usages as electrical appliances and lighting. In Linz, about 80 tenants could make use of the eSESH service - either the EAS or the EMS for tenants. The remaining tenants belong to a predefined control group and therefore they didn't get the possibility to use the eSESH service.

Before analysing the data it was necessary to cleanse it in order to take into account the change of tenancy as well as some incoherencies or periods of absence of the tenants. In these cases, these dwellings were excluded from the analysis. The dataset analysed represents nearly 80% of the total dataset. The difference between the number of pilot dwellings and dwellings with measurements was due to partly late move-in date of tenants.

Table 4-41: Description of the cleansing step

Cleansing			
Data	Site	Number of dwellings	
		Before cleansing	After cleansing
Electricity	Total	195	166
Heating	Total	191	159

For calculating the savings a pre-post comparison has been used. The eSESH service started operation in November 2011 for the EAS service and in January 2012 for the EMS service. According to that, the pre-post comparison is based on the analysis of the evolution of the

consumption figures before and after the implementation of the service. To facilitate the analysis of the results the baseline period covers the month 01/07/2011 – 31/12/2011, the reporting period covers the whole year 2012 (01/01/2012 – 31/12/2012). It is not a very large range of time but it is sufficient to extract first conclusions about the impact of the eSESH service. The baseline is composed by the last semester of the year 2011. As a consequence some values are given on a bi-annual level.

Global results of electricity and heating analysis

The calculation of the savings combined for the two experimental groups (EAS and EMS) led to the following results:

Table 4-42: Overview of global results in Linz

Key data		
	Electricity	Heating
Number of dwellings	64	59
Surface area (average)	203	211
Number of people (average)	-	-
Global Results for the dataset of dwellings		
	Electricity	Heating
Savings (%) - eeMeasure (weighted)	4,70%	6,50%
Saving (kWh/yr or m3/yr) - eeMeasure	8 180	14 680
Carbon Dioxid Reduction in kgCO2/yr- eeMeasure	2 536	3 479
Financial Saving (€/yr) - eeMeasure	1 911	1 028
Consumption Before Intervention (kWh) - 6 months	73 443	80 175
Results (per dwelling, per people or per m²)		
	Electricity	Heating
Consumption Unit	*(kWh/m².semester)*	*(kWh/m².semester)*
Consumption - Before intervention	11,3	12,9
Consumption - After intervention	10,7	12,0
Consumption Unit	*(kWh/dwelling.year)*	*(kWh/dwelling.year)*
Consumption - Before intervention	2 295	2 718
Consumption - In the same country* (annual average)	3125*	-
Saving (kWh/dwelling.yr or m3/dwelling.yr)	127,8	248,8
Carbon Dioxid Reduction in kgCO2/dwelling.yr	39,6	59,0
Financial Saving (€/dwelling.yr)	29,9	17,4
** See references*		

In total these tenants achieved savings of nearly 5 % electricity and 6.5% heating. Compared to the total savings target of 5% (described in the evaluation planning deliverable D7.1) these results can be treated as success.

The differentiation of EAS and EMS users clearly shows that the best results are obtained when the EMS service is used. Related to the EMS group the observed savings are much higher – 9% savings for electricity, 14 % savings of heating. Compared to that, the results of the predefined control group are significantly lower than expected.

Table 4-43*:* Percentage of savings for the Control Group, EAS and EMS service

Savings - eeMeasure (weighted)	Electricity	Heating
Control Group	1,5%	2,3%
EAS	3,0%	2,4%
EMS	9,1%	14,3%

Electricity

For electricity, it is important to compare the levels of annual electricity consumption per m². The two graphs below show that the consumption of the dwelling is not correlated to its size. This is due to the imponderables of any dwelling (TV, household appliances…).

Figure 4-86: Electricity Consumption (in kWh/m²) for the Second Semester **2011 related to the surface of the dwelling in m², for EAS and EMS Groups**

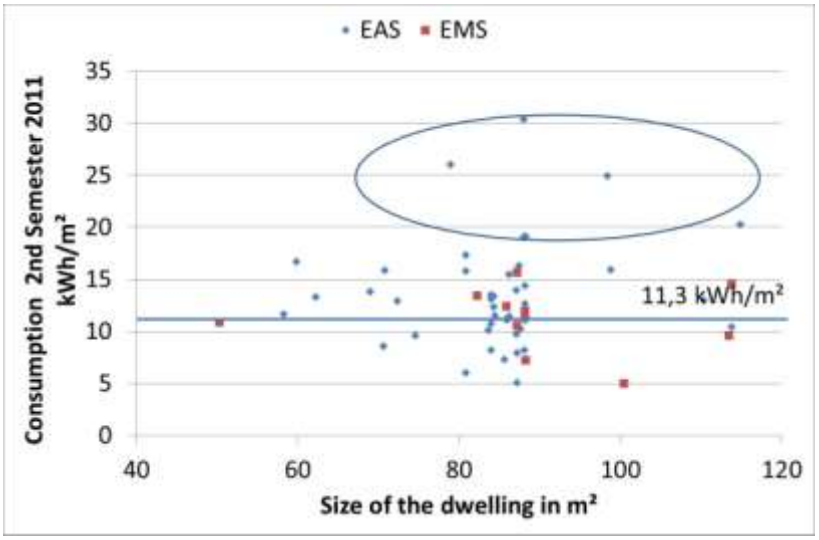
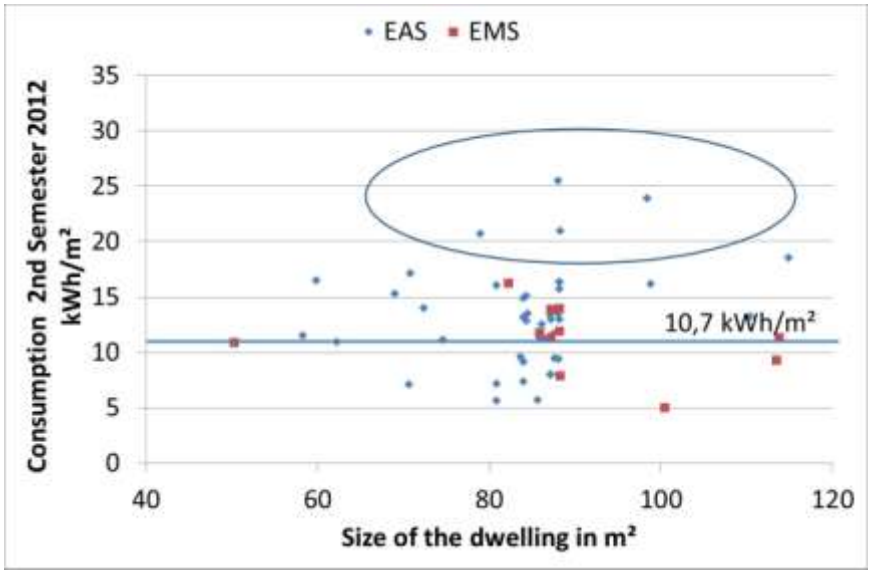


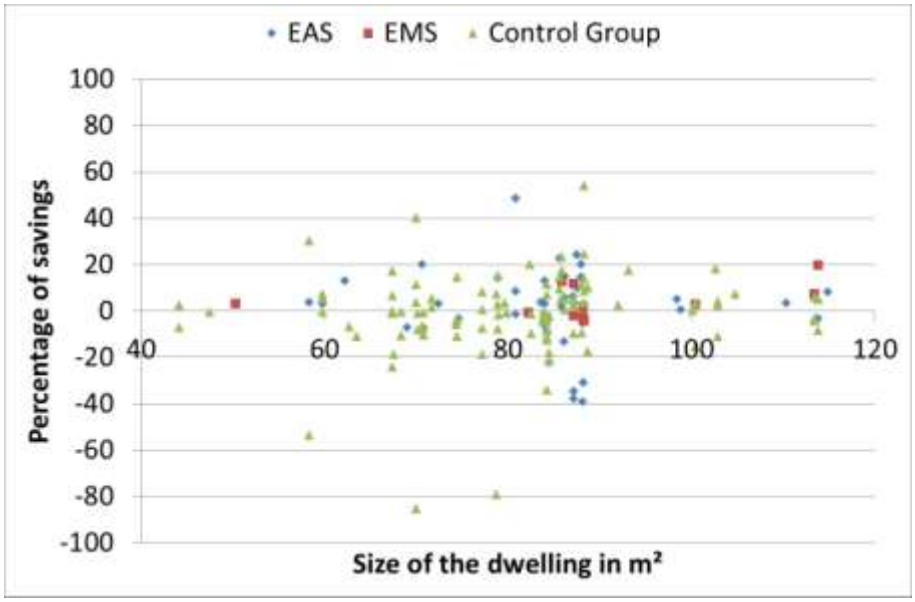
Figure 4-87: Electricity Consumption (in kWh/m²) for the Second Semester **2012 related to the surface of the dwelling in m², for EAS and EMS Groups**



It was further of interest to study the relation between the percentage of savings and the size of the dwelling. The following figure shows that a significant number of tenants made savings. Indeed, 60% of the EAS group and actually 68% of the EMS group achieved savings. Moreover, as shown in the table above, the level of savings in both groups is divergent and much better for the EMS group (3% savings in the EAS group, 9% in the EMS group).

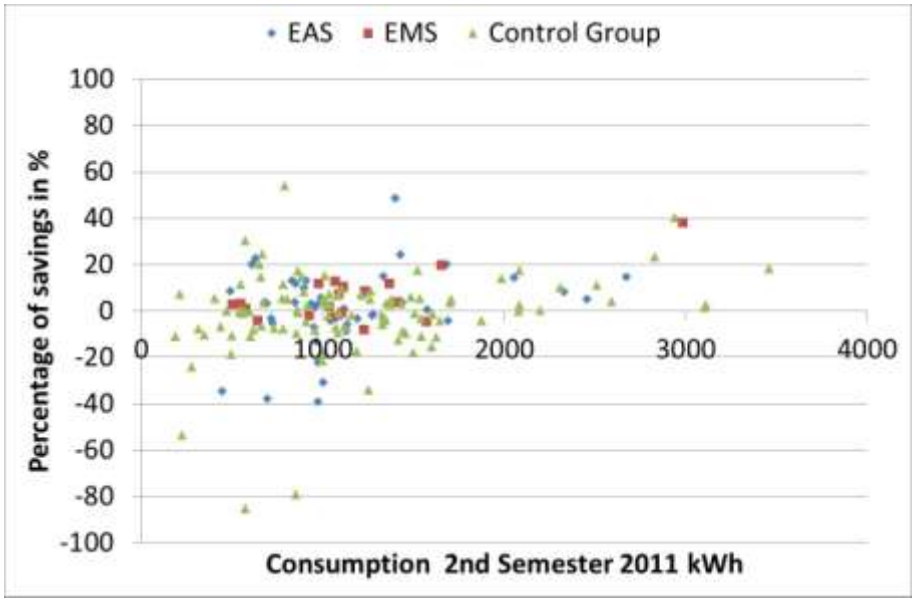
Besides, the graph below shows no correlation between the size of the dwelling and the percentage of savings.

Figure 4-88: Percentage of savings (+ values) related to the surface of the dwelling in m², for Control group, EAS and EMS Groups



In the following figure the surface of the dwelling has been replaced by the annual electricity consumption of the baseline period.

Figure 4-89: Percentage of savings (+ values) related to bi-annual electricity consumption in kWh



Heating

In the following, at first the level of annual gas consumption before service implementation has been compared with this level after service implementation. From the two followings charts a global decrease of heat energy consumption can be observed. In addition to that a tendency becomes obvious to settle down under the mark of 20kWh/m² heat energy consumption per year. This decrease is more pronounced for the EMS group.

Figure 4-90: Consumption (in kWh/m²) for the Second Semester **2011 related to the surface of the dwelling in m², for EAS and EMS Groups**

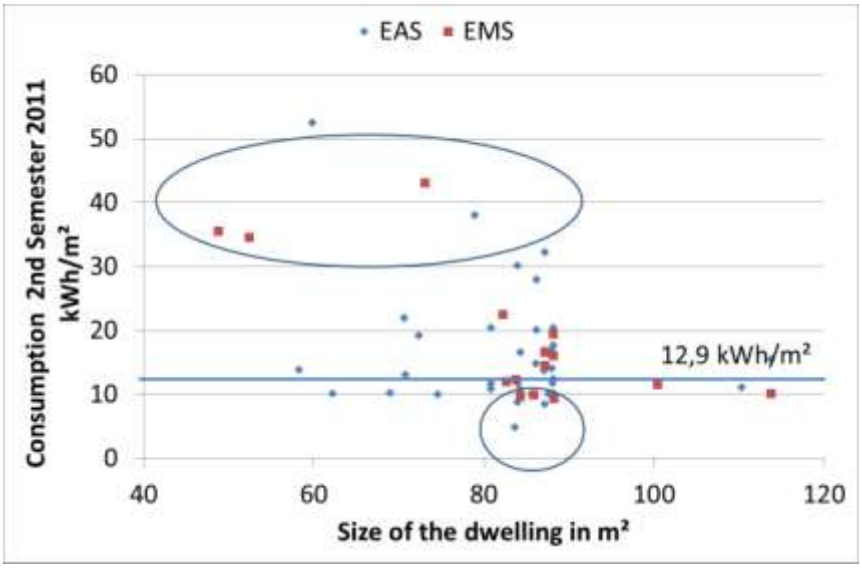
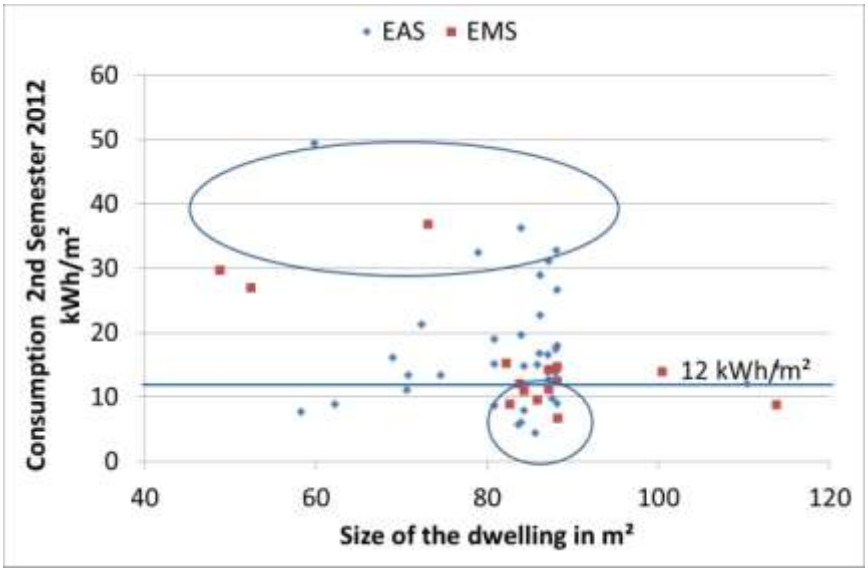


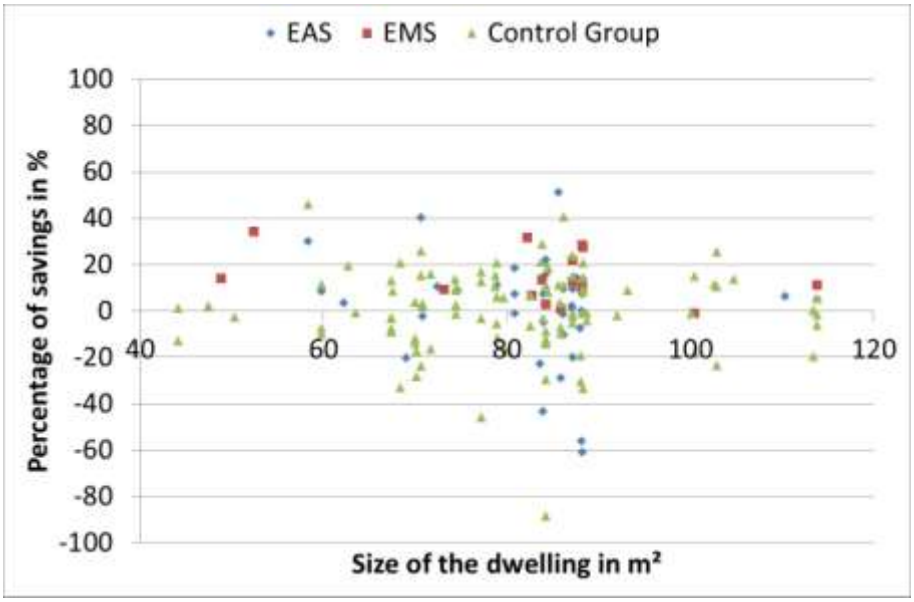
Figure 4-91: Consumption (in kWh/m²) for the Second Semester **2012 related to the surface of the dwelling in m², for EAS and EMS Groups**



The chart below shows, that a significant number of dwellings made savings. Indeed, 63% of the EAS group and even 90% of the EMS group achieved heating savings. Moreover, as shown in the table above, the level of savings in both groups is divergent and much better for the EMS group

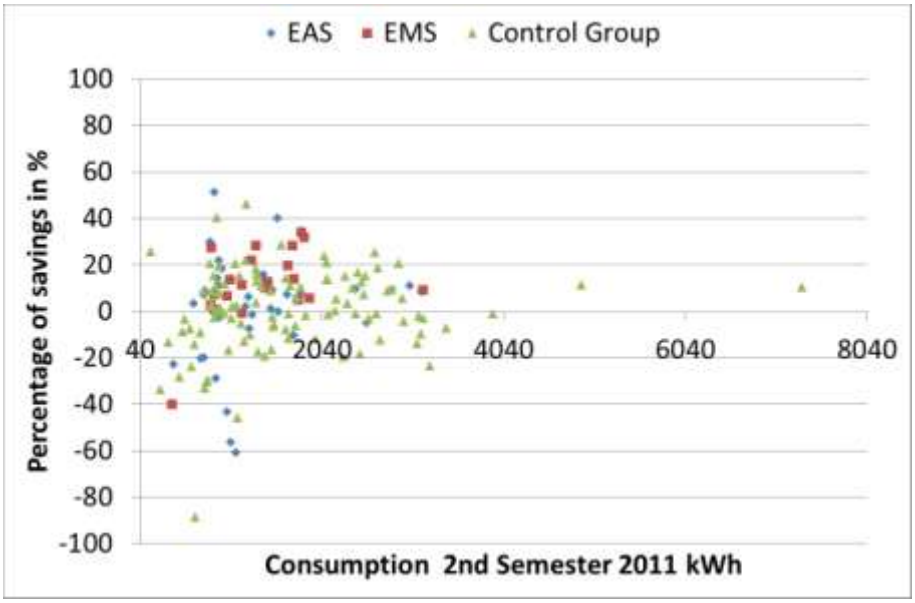
(2.4% savings in the EAS group, 14.3% in the EMS group). Besides, there seems to be no correlation between the size of the dwellings and the percentage of savings.

Figure 4-92: Percentage of savings (in %) related to the surface of the dwelling in m², for Control group, EAS and EMS Groups



In the following figure the surface of the dwelling has been replaced by the annual heat energy consumption of the baseline period.

Figure 4-93: Percentage of savings (+ values) related to bi-annual heat energy consumption in kWh



Thanks to this graph, it appears that the dwellings which had the best results are low consumers. As a consequence, it could be interesting to launch specific actions dedicated to the high consumers. These actions would have an important impact on the whole results.

Comparison between users and non-users

A pre-post comparison between service users and non-users was possible for electricity as well as heating.

Table 4-44: Distribution of users and non-users in the consumption dataset and results

Comparison between users and non-users					
		Electricity		Heating	
Total of dwellings	Users	13	20%	14	24%
	Non Users	51	80%	45	76%
	Total	64	100%	59	100%
Surface per dwelling	Users	84,56		81,25	
	Non Users	70,81		72,59	
People per dwelling	Users	-		-	
	Non Users	-		-	
Average Annual Consumption 2011 (baseline period)	*Unit*	*kWh/(dw.year) in 2011*		*kWh/(dw.year) in 2011*	
	Users	1087		1325	
	Non Users	1115		1287	
% of dwellings which made savings	Users	62%		85%	
	Non Users	63%		63%	
	Total	63%		67%	
Savings (%)	Users	8,50%		10,10%	
	Non Users	3,80%		5,50%	

As expected, the comparison between users and non-users shows that the use of the service has a positive impact on consumption reduction. Indeed, the users of the EAS/EMS service made 8.5% electricity savings and 10.1% savings of heat energy. Moreover, regarding heating, 85% of the users achieved significant savings (compared to 63% of non-users). For electricity, this result is less interesting as the proportion of dwellings which made savings is equal for user and non-users.

The two charts below show these good results of the users of the service.

Figure 4-94: Percentage of savings (+ values) related to bi-annual electricity consumption in kWh

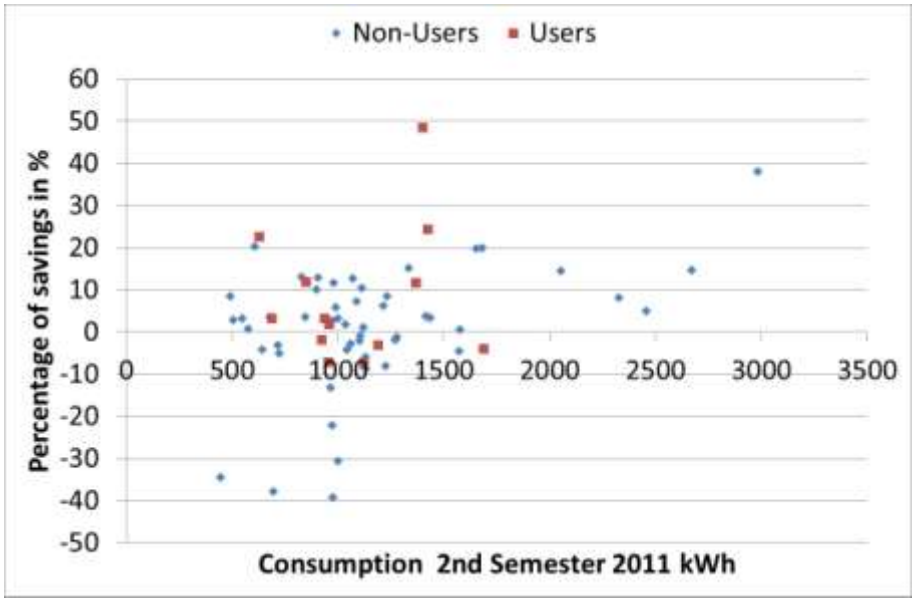
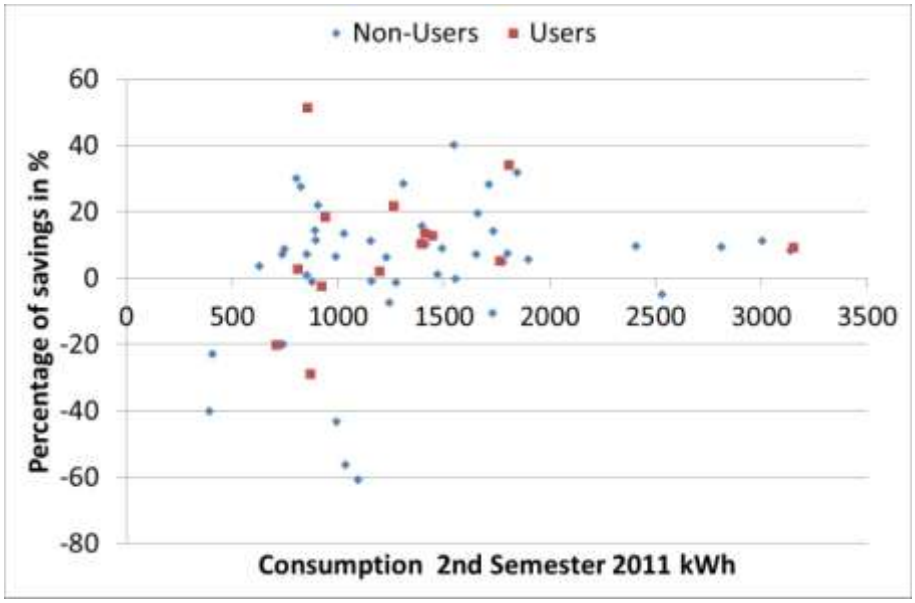


Figure 4-95: Percentage of savings (+ values) related to bi-annual heating consumption in kWh



4.6.3 Results of tenant survey analysis

The Linz pilot site carried out two tenant surveys addressed to the tenants belonging to both the EAS group and the EMS group which were carried out once in the baseline and once in the reporting period.

Primarily it was also planned to carry out a survey with the control group. The control group is by design a group which does not receive any information for ensuring the comparison with EAS and EMS. This survey was skipped after a revision with market professionals.

Table 4-45: Overview of sample sizes of the Linz tenant surveys

	Baseline survey	Final survey
EAS group	n=48	n=44
EMS group	n=33	n=20

The surveys with the EAS group focussed on socio-demographic characteristics and energy consumption behaviour resp. attitudes regarding energy saving. Both survey were analysed and reported in a brochure by GWG. Most of the results have been integrated in the following section again. The EAS surveys can only be interpreted limited because the survey data couldn't be linked with the consumption data analysis because of data protection issues. For the same reason a differentiation between users and non-users related to the survey is not possible.

Regarding EMS the first survey included also questions regarding energy consumption behaviour and attitudes. In order to avoid a big drop-out the questionnaire of the final survey was very short and focussed only on EMS usage. From 18 EMS tenants (53% of the total number of EMS tenants) were data for both survey stages available.

The following table gives a summary of the socio-demographic characteristic of the respondents. In general, the respondents are comparably younger than at other pilot sites and well-educated.

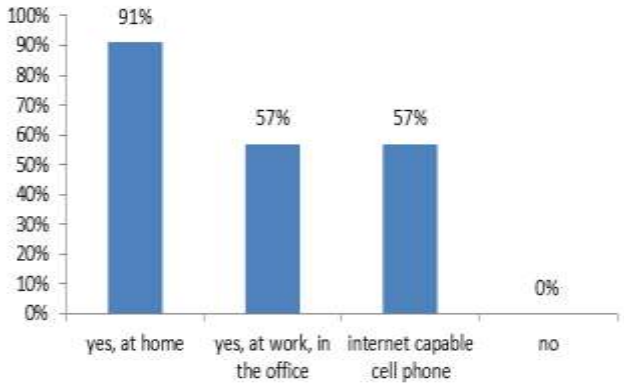
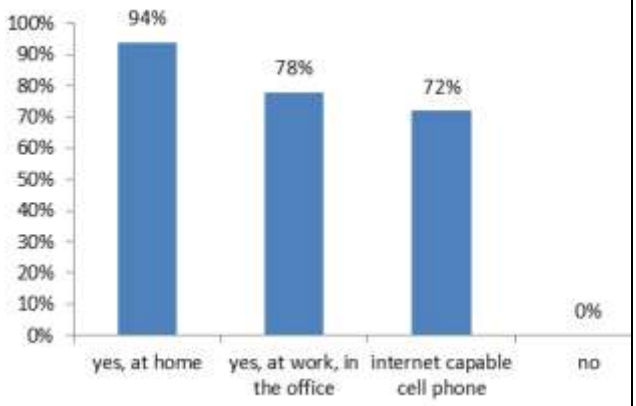
Table 4-46: Socio-demographic characteristics of the final survey respondents

	EAS group (final survey, n=44)	EMS group (final survey, n=18)[11]
Sex	25 women (57%), 19 men (43%)	8 women (39%), 12 men (61%)
Average age	38.9 years	39.1 years
Household size	55 % two-person-households, 39 % households with children	39% two-person-households, 31% households with children
Education level	high: 36% university/university of applied science degree	high: 31% university degree, 19% doctor's degree

All tenants in both samples have access to the internet either at home, at work or by an internet capable cell phone.

[11] Socio-demographic characteristics have been asked only in the baseline survey. With help of the tenant ID it is feasible to assign the socio-demographic information from the baseline survey to those tenants who were interviewed in the final survey too.

Figure 4-96: Internet access of EAS and EMS group

EAS group	EMS group
	

Results from the survey analysis of the EAS group

Energy consumption behaviour and attitudes regarding energy saving

As above described the analysis of the EAS tenant surveys were hindered by the missing possibility (ID availability) to allocate the before-after data to the relevant tenant households. However, in the final survey were only 4 tenants missing who participated in the baseline survey, but not in the final survey. That's why a pre-post comparison is to a limited extent possible. With this restriction the following figure shows that there are positive trends obvious:

- Except the turn off of the heating when opening the windows, in the final survey more tenants reported on optimal heat energy consumption behaviour compared to the baseline survey. Especially increased is – for example – the percentage of tenants who have an automatic night lowering of the heating (now 64% compared to before 31%) which normally has a big impact on energy reduction. In addition to that the majority of respondents reported on efficient heating behaviour regarding a turned down heating when they leave their home for a longer time or when they leave a room unused.
- Also regarding the electricity use the final survey shows good results: All tenants switch off the light when no one is in the room, wait until a full load when using the washing machine or dish washer and keep the energy efficiency in mind when they want to buy new electrical devices. Nearly all switch off their TV or the like when no one is in the room.
- In addition to that the majority of tenants mind their hot water consumption.
- Nearly all tenants separate their waste.

Table 4-47: Energy consumption behaviour patterns (percentages of 'yes'/'rather yes')

	Baseline survey (EAS, n=48)	Final survey (EAS, n=44)
Do you turn off the heating/ the radiator when you open the windows?	23	9
Do you turn the heating down when you leave a room unused?	72	91
Do you turn the heating down when you leave your home for a longer time?	82	86
Is your heating equipped with automatic night setback?	31	64
If you don't have an automatic night setback: Is your temperature at night usually lower than at day?	32	48
In winter time: Do you mind to keep shut the windows and doors of the commonly used rooms (basement, staircase, etc.)?	67	80
Do you switch off the light when no one is in the room?	97	100
Do you switch of TV or other appliances when no one is in the room for a longer time?	87	95
Do you completely switch off an appliance with stand-by function when you have finished using it?	67	59
Do you wait until you have a full load before you use your washing machine or dish washer?	98	100
Do you mind the energy consumption when you purchase new electrical appliances?	93	100
Do you separate your waste?	95	93
Do you use cold water to wash your hands?	46	54
Do you rather take a shower instead of a bath?	90	89

Ventilating in winter or on colder days causes heat losses. If tenants leave their windows ajar often or all the time only less fresh air comes in while a lot of heat goes out. Therefore the more efficient way of ventilating the dwelling is to open the windows shortly widely at times. As the following table related to the different room use shows, most of the tenants already keep that problem in mind and try to avoid to keep their windows ajar for a longer time. The only exception is the bathroom where the fewest ventilate by opening the window widely at times.

Table 4-48: Percentage of reported ventilating by opening the windows widely at times

Room	Baseline survey (EAS, n=48)	Final survey (EAS, n=44)
Living room	82%	82%
Bedroom	64%	70%
Kitchen	47%	77%
Bathroom	34%	26%
Other room (for example nursery)	59%	66%

Related to attitudes and knowledge about energy issues the following table shows, that a large majority of respondents was already environmentally conscious when asking them the first time. Compared to baseline in the final survey significantly more respondents reported that they are interested in the possibilities of saving energy at home and in their energy consumption at home. It can be assumed that this is an impact of the EAS use resp. the information campaign the Linz pilot site carried out[12].

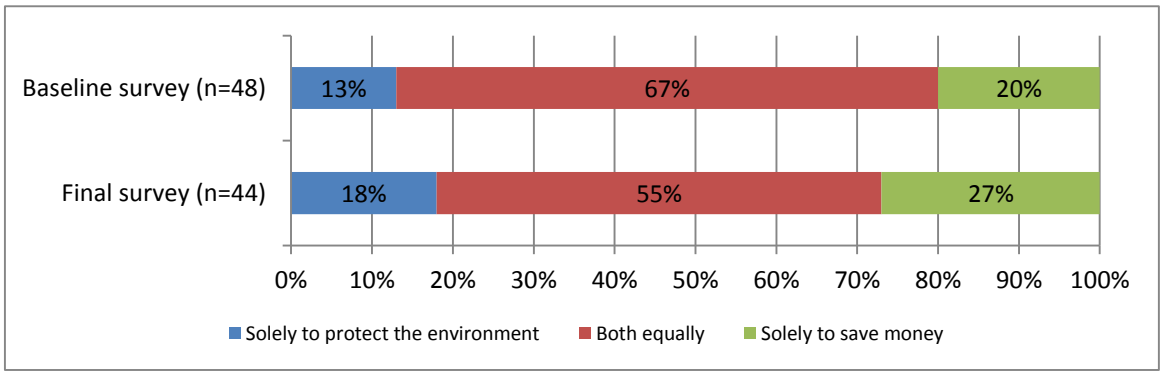
Table 4-49: Attitudes towards environmental and energy issues (percentages of 'strongly agree'/'rather agree')

	Baseline survey (EAS, n=48)	Final survey (EAS, n=44)
I think I should save more energy at home.	62	52
My family or friends think that I should save more energy at home.	8	19
In my opinion protecting the environment is very important.	92	98
To ensure the decrease of CO2 emissions is important for the protection of the environment.	87	88
I am interested in my energy consumption at home.	69	91
I am interested in possibilities of saving energy at home.	74	95
Energy conservation means I have to live less comfortably.	21	14
Energy consumption will restrict my freedom.	16	11
I can reduce my energy consumption quite easily.	59	45
I know how to save energy.	87	91

[12] As mentioned before it was not possible to identify EAS users and non-users in the survey sample.

Most of the respondents see the protection of the environment as well as the saving of money as motivation to save energy.

Figure 4-97: Responses to the question "Which motivates you more to save energy – protecting the environment or saving money?



Assessment of the EAS web portal

In the final survey the EAS tenants have been asked about their experiences with the tenant portal. In view of the fact that it was not possible to assign the actual service use to the responses it can only be assumed that tenants with 'no experiences' (see the following table) were very likely non-users. In doing so, the following table shows that men were more interested in EAS use than women. The same applies to better educated persons compared with less educated tenants.

Table 4-50: What has been your experience with the internet portal of Linz AG? (n=44)

Group	Very good experiences	Rather good experiences	Less good experiences	Bad experiences	No experiences
In total	7%	32%	5%	-	57%
Female	4%	24%	8%	-	64%
Male	11%	42%	-	-	47%
1 Person household	-	57%	-	-	43%
2 Person household	-	29%	8%	-	63%
3 Person household	25%	-	-	-	75%
4 Person household	20%	60%	-	-	20%
Until 35 years old	-	45%	-	-	55%
36 – 45 years old	7%	29%	7%	-	57%
46 and more years old	20%	10%	10%	-	60%
University	13%	31%	13%	-	43%
Secondary school	-	43%	-	-	57%
Apprentice or no	8%	15%	-	-	77%

degree					

Those who reported on experiences with the EAS use predominantly have very good or rather good ones. No one made bad experiences.

Nevertheless, good experiences not always come along with an increased energy awareness caused by the EAS use. As the following table shows the respondent opinion regarding that question is here circa half/half. Half of the portal users reported about an increased awareness - elderly more often than younger people, the other half not.

Table 4-51: Responses to the question: Is your energy awareness increased because of the use of the Internet portal of Linz AG? (n=44)

Group	I strongly agree	I rather agree	I rather disagree	I strongly disagree	I don't know
In total	2%	23%	14%	16%	45%
Female	4%	16%	20%	4%	56%
Male	-	32%	5%	32%	32%
1 Person household	-	14%	29%	-	57%
2 Person household	-	25%	17%	13%	46%
3 Person household	-	25%	-	25%	50%
4 Person household	20%	20%	-	40%	20%
Until 35 years old	-	10%	10%	10%	70%
36 – 45 years old	7%	21%	7%	36%	29%
46 and more years old	-	50%	30%	-	20%
University	-	38%	38%	6%	19%
Secondary school	-	7%	-	43%	50%
Apprentice or no degree	8%	15%	-	-	77%

Results from the survey analysis of the EMS group

Energy consumption behaviour and attitudes regarding energy saving

As mentioned above the energy consumption behaviour was part of the baseline survey of the EMS group only. That means, a pre-post-comparison of that group was not possible. Nevertheless, a comparison between EAS group and EMS group was possible. As the following table shows the reported behaviour of the EMS group was already often better than that of the EAS before service implementation. This greater energy awareness could be one of the reasons why this group was more interested in the use of the EMS iPod which provides more features (switching and control equipment) than the EAS used by the other group.

Table 4-52: Energy consumption behaviour patterns (percentages of 'yes'/'rather yes')

	Baseline survey (EMS, n=33)	Baseline survey (EAS, n=48)
Do you turn off the heating/ the radiator when you open the windows?	34	23
Do you turn the heating down when you leave a room unused?	88	72
Do you turn the heating down when you leave your home for a longer time?	81	82
Is your heating equipped with automatic night setback?	64	31
If you don't have an automatic night setback: Is your temperature at night usually lower than at day?	48	32
In winter time: Do you mind to keep shut the windows and doors of the commonly used rooms (basement, staircase, etc.)?	72	67
Do you switch off the light when no one is in the room?	100	97
Do you switch of TV or other appliances when no one is in the room for a longer time?	97	87
Do you completely switch off an appliance with stand-by function when you have finished using it?	72	67
Do you wait until you have a full load before you use your washing machine or dish washer?	97	98
Do you mind the energy consumption when you purchase new electrical appliances?	84	93
Do you separate your waste?	100	95
Do you use cold water to wash your hands?	56	46
Do you rather take a shower instead of a bath?	84	90

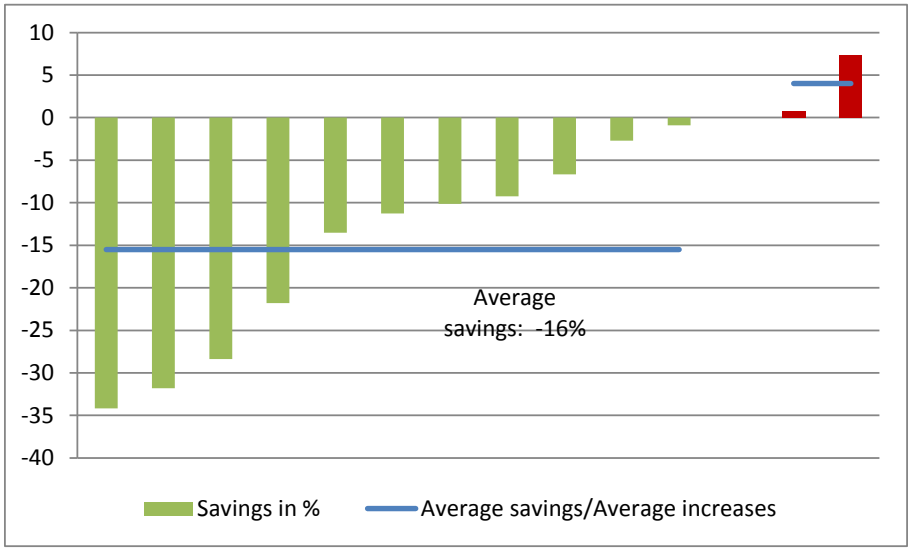
That impression increases when comparing the attitudes towards energy related attitudes. The later EMS users much more often reported a subjective (I think I should save more energy.) and social (My family thinks I should save more energy.) energy saving norm, were more conservation-conscious and strongly more interested in energy consumption issues. This suggests that already energy-conscious people have a strong demand for systems which allows them not only to get a consumption overview, but also to manage their energy consumption by themselves.

Table 4-53: Attitudes towards environmental and energy issues (percentages of 'strongly agree'/'rather agree')

	Baseline survey (EMS, n=33)	Baseline survey (EAS, n=48)
I think I should save more energy at home.	97	62
My family or friends think that I should save more energy at home.	35	8
In my opinion protecting the environment is very important.	100	92
To ensure the decrease of CO2 emissions is important for the protection of the environment.	97	87
I am interested in my energy consumption at home.	100	69
I am interested in possibilities of saving energy at home.	97	74
Energy conservation means I have to live less comfortably.	27	21
Energy consumption will restrict my freedom.	6	16
I can reduce my energy consumption quite easily.	67	59
I know how to save energy.	87	87

In addition to that, in the baseline survey the EMS tenants have been asked about their expected savings ('I expect a significant reduction (at least 5%) of my heating energy consumption.'). Nearly 85% strongly resp. rather agreed and most of them were proved correct. In detail shows the following figures that most of these tenants achieved heat energy savings ranged from 1% to 34 %, on average 16%.

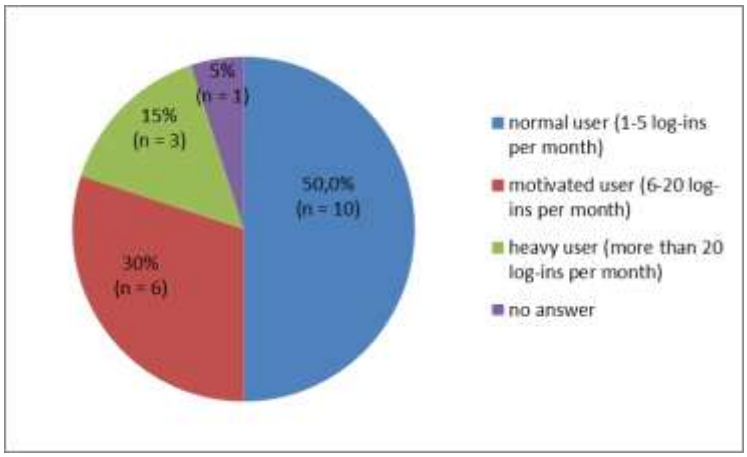
Figure 4-98: Consumption data evolution of those EMS tenants who expected a significant reduction of heat energy (reported in EMS baseline survey)



Assessment of EMS by users

In the final EMS survey the tenants have been asked how often per month they read out the consumption data with their iPod. The use frequency ranges from 1 up to 30 usages per month. On average tenants check their energy consumption data 9 times per month. According to the answers the tenants have been divided into three user groups (see following figure).

Figure 4-99: Service usage: How often are the consumption data read per month with iPod? (n=20)

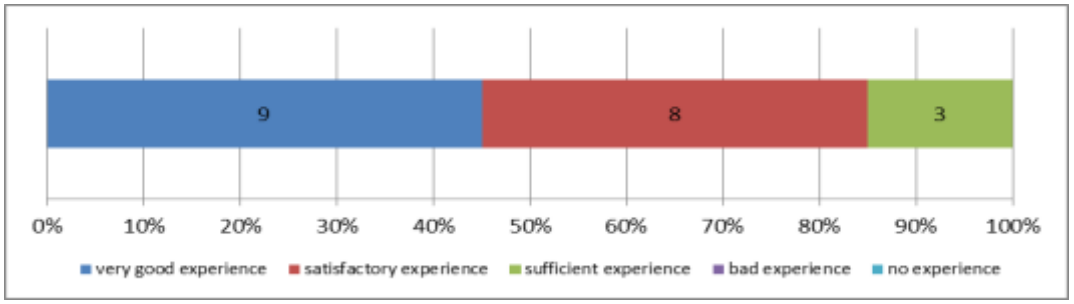


Due to consumption data cleansing, from the 20 interviews realised in the final EMS survey eight cases only could be included where survey data as well as consumption data were available. Nevertheless, the analysis of that small sample suggests, that the use frequency seems to have an impact on energy savings:

- The so included moderate and heavy EMS users (n=4) achieved average heat energy savings of nearly 19%. The savings ranged from 13% up to 28%. No one in that group had a measured increased consumption.
- Two of the weak EMS users achieved also heat energy savings of 3% resp. 11%, one achieved electricity savings of 20%. The remaining tenant in that group had an increased heat energy consumption of +7%.

15 of the 20 respondents (75%) reported on increased energy awareness due to the EMS. In addition to that, all tenants participated in the final EMS survey made good experiences with their iPods in order to get information resp. to manage their energy consumption. 17 of the total 20 tenants reported on very good resp. satisfactory experiences. For the remaining three tenants the provided EMS solution was sufficient.

Figure 4-100: Reported satisfaction with the EMS (n=20)



11 of the 20 respondents (55%) use the so called “Green Plug” in order to control their end consumers. Thereof 8 respondents made very good resp. satisfactory experiences. The remaining three tenants assessed their experiences as sufficiently.

At the end of the final survey the EMS users could suggest in an open-ended question improvements of the EMS. The results are as follows:

Table 4-54: Which additional EMS information and/or services you would like to have?

Suggestions	Number of respondents
Improvement of the graphical representation	3
Problems with WiFi, improving the wireless network	2
Representation of the cost per kWh	2
Display at the heating station (additional graphics?)	1
Comparison values (normal consumption)	1
Usage of Green Plug unclear	1
Data access with 3G	1
Some detail inquiries (more details)	1
Offer available for Android mobile phone	1
Improved (software) Control	1
Consultation by Linz AG desired	1
Consumption on a daily basis	1
Measurements	1
Total	17

4.7 Moulins

4.7.1 Background information

The Moulins pilot site developed an EAS as well as an EMS. The global aim of the EAS is an overall energy saving to reduce tenant's costs. The service is based on monitoring data which are clearly and easily presented to tenants on an in-home display or on the TV screen.

The EMS has been developed in order to monitor the heating system and to assure its good performance. A bad and/or not regulated system leads to higher energy consumption and related higher energy bills for tenants.

Figure 4-101: Examples of EAS (left) and EMS (right)

Every pilot tenant received monthly letters for user recruitment which will be continued in the future to motivate them and also to give to them tools and tips on how to save energy (eco charge). Tools provided to tenants to save energy and serving as incentives are for example:

- One or two energy saving bulbs
- A small equipment to install in the toilets to reduce the volume (half one) of the lavatory flush
- Brochures on good behaviour to save energy (water, heating, electricity).

This "pack" is given or bought (cheap price) by energy providers (e.g. GDF or EDF). The first letters were sent in September 2011. Training sessions have been made in les Chartreux in November 2011. The 15-minutes-training sessions were made directly in the dwelling because Moulins Habitat (MH) wanted to have a direct contact to the tenant in order to answer his/her specific questions.

Moulins Habitat (MH, social housing provider) staff has been already trained for the Vizelia tool regarding hot/cold water and temperature. A further training session is necessary for electricity but the user interface remains the same.

In total, 399 dwellings located in six buildings were involved in the Moulins pilot site.

Table 4-55: Overview of the number of buildings and dwellings involved in the Moulins pilot[13]

Site	Pilot site name	Number of buildings involved	Number of dwellings involved
Moulins	Les Chartreux	6	399

The EAS service (water and indoor temperature; see explanation below) started operation in January 2012. Via log-in measurement in total 198 tenants can be counted as users the eSESH service. That equates to nearly 50% of the pilot tenants.

4.7.2 Results of consumption data analysis

The development of EAS has been problematic and could not be finalised in time. The current version of eSESH EAS contains feedback on water consumption figures in combination with water saving tips and provides information on indoor temperatures.

Regarding electricity measurement only annual values (for 2010, 2011, 2012) at building level (not individually for each dwelling) are available. Throughout the project Moulins Habitat has tried to obtain electricity consumption data for each dwelling of the pilot site from ERDF (the national electricity distributor) but without success. The French law regarding data protection is different for electricity which is considered as a private data so the process is much longer than for water or heating. MH first needs the approval of the customer to ask ERDF for an individual meter. MH also needs an approval from each tenant to have access to his electricity consumption data for the eSESH project. Then, a letter has been sent to ERDF with the authorization attached. The time for ERDF to respond was quite long because it was a “standard” process for them. Actually, ERDF is used to activate the TIC link only for resellers (like EDF, POWEO) but not for social housing companies so they had to check whether this was in accordance with the law for data protection. Once this step validated, they sent a proposal dwelling per dwelling. MH then had to check if they had the approval of the tenant (that usually needed face to face explanations to obtain the signature). Afterwards MH sent the purchase order. ERDF scheduled the intervention inside the dwellings (new organization to call the tenants, check their availability, confirm the intervention dwelling per dwelling, etc.). After ERDF job is done, Lyonnaise des Eaux then had to come back in each equipped dwelling to install and activate the meter that collects the electricity consumption data. Finally, MH made a final check in February 2013 to validate that data are recorded in the database. The TV portal was already developed to display electricity consumptions so the system is now ready to display electricity consumptions through the TV and the videophones.

Today, in February 2013, 82 dwellings have been equipped and connected successfully after ERDF has given their approval in January 2013, i.e. long time after the whole process had started. Electricity consumption data per dwelling will now become available from April 2013 onwards and displayed on the TV sets of the tenants next to the visualisation of the water consumption data which has led to significant savings of 24% for hot water and 12% for cold water (see below) which

[13] Originally was planned to involve another sub-site (Moulins Sud, 80 dwellings). In Moulins Sud a first version of water consumption feedback via EAS already existed which should be improved during the eSESH project by further provision of electricity and heating data and information. Due to the described problems in section ‘Results of consumption data analysis’ this pilot site has to be excluded from an analysis. However, also the tenants of Moulins Sud participated in the tenant trainings and tenant events.

is seen as a huge success by all parties concerned. However, and in order to measure energy savings historical consumption data would be required. Again, ERDF argues that this can only be obtained with the explicit tenant permission. The possibilities for achieving access to historical energy consumption data are currently investigated.

Also related to heating measurement only annual values for 2010, 2011, 2012 at building level (not individually for each dwelling) are available. The focus of the EMS in Moulins was on implementing temperature and humidity sensors in each dwelling and visualising the measurements of both to the building management staff and to responsible persons at MH in order to ensure that in all dwellings a minimum temperature of 19°C during the day and 17°C at night time could be reached. That is the value housing companies have to guarantee to their tenants according to the law. Again – as described above regarding 'electricity' – MH did not have any possibility to develop and to implement a more sophisticated EMS/EAS service due to the monopolistic gas distribution situation in France. The monopolist GRDF does not show any interest in proving measurement data and in supporting further EAS development in eSESH. Gas distribution for heating in Moulins has been outsourced by the city of Moulins to Cofely, a subsidiary of GDF, which did not show any interest in cooperation to enable such a service to be implemented. Moreover, there is less interest in implementing individual meters and sensors for heating because it is invoiced in accordance with the size of the dwelling (m²).

MH and other social housing companies in France are obliged to respect the 19°C for each dwelling. Depending on the statement that the temperature is respected, MH Habitat was able to decrease the heat energy consumption in some buildings. But there are other buildings (mainly North-oriented) were the 19°C could not be reached, so MH had to increase the consumptions for these ones. To sum up, MH was not able to meter the heating consumption but has preferred monitoring the heating service which is analysed by the temperature in each dwelling.

Water consumption analysis

In Les Chartreux cold and hot water have been measured on an annual basis in 399 dwellings.

Before analysing the data it was necessary to cleanse it in order to take into account the change of tenancy as well as some incoherencies or periods of absence of the tenants. In these cases, the dwellings were excluded from the analysis. The dataset analysed represents nearly 86% of the total number of dwellings.

Table 4-56: Description of the cleansing step

Cleansing		
Data	Number of dwellings	
	Before cleansing	After cleansing
Hot water	399	342
Cold water	399	348

For calculation of savings a pre-post comparison has been used. In view of the eSESH service operation start in January 2012, the pre-post comparison is based on the analysis of the evolution

of the consumption before ((01/01/2010 – 31/12/2011) and after the implementation of the service (01/01/2012 – 31/12/2012).

The calculation of savings led to the global results showed in the following table. Therefore total savings of 24.3% domestic hot water (DHW) and 12.5 % cold water have been observed. Compared to the expected savings of 17% (see deliverable D7.1), the DHW savings completely met the target.

Table 4-57: Overview of global results in Moulins

Key data		
	Hot water	Cold water
Number of dwellings	342	348
Surface area (average)	61	61
Number of people (average)	1,45	1,45
Global Results for the dataset of dwellings		
	Hot water	Cold water
Savings (%) - eeMeasure (weighted)	24,3%	12,5%
Saving (m3/yr) - eeMeasure	2 152	1 861
Carbon Dioxid Reduction in kgCO2/yr- eeMeasure	-	-
Financial Saving (€/yr) - eeMeasure	17 885	4 466
Consumption Before Intervention (m3/yr)	8 840	14 870
Results per dwelling or per people		
	Hot water	Cold water
Consumption Unit	*(m3/people.year)*	*(m3/people.year)*
Consumption - Before intervention	18	29
Consumption - After intervention	12	24
Consumption Unit	*(m3/people.year)*	*(m3/people.year)*
Consumption - Before intervention	18	29
Consumption - In the same country*	51	
Savings	6	5
Carbon Dioxid Reduction in kgCO2/dwelling.yr	-	-
Financial Saving (€/dwelling.yr)	52	13
** See references*		

Hot Water

For DHW it is important to refer the level of annual consumption to the number of people living in the dwelling. The two graphs below highlight the big decrease of DHW consumption in the pre-post-comparison.

Figure 4-102: Annual hot water consumption (in m3/person) related to the surface of the dwelling in m², in 2010

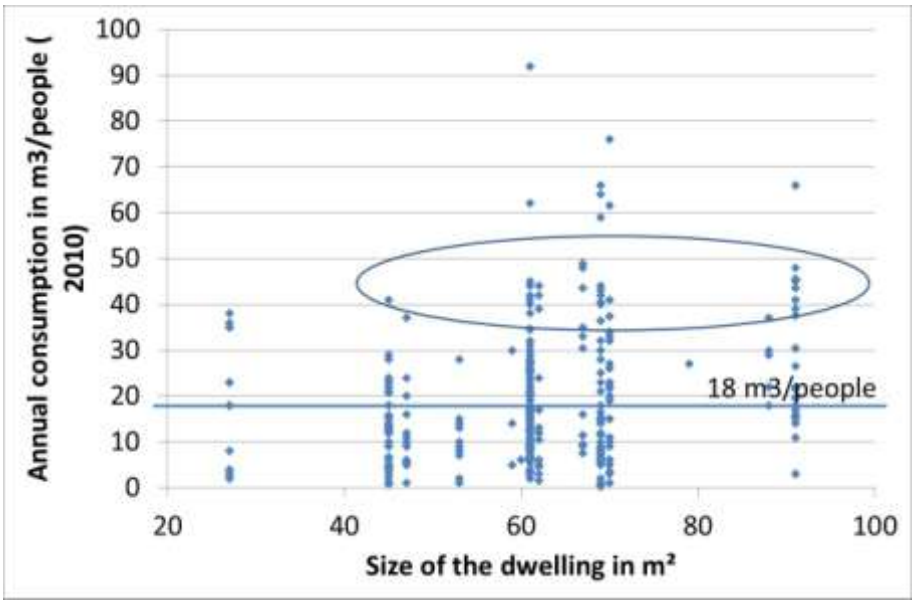
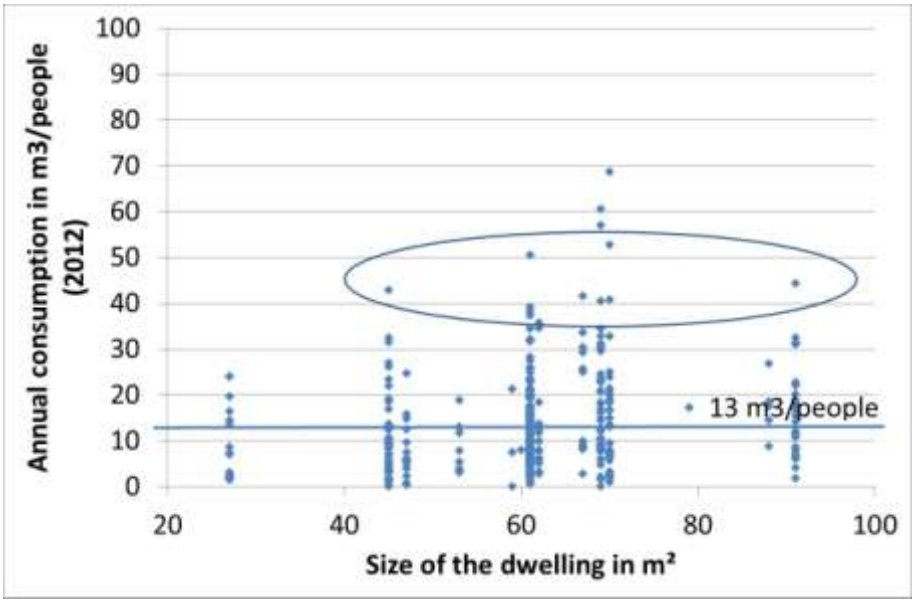


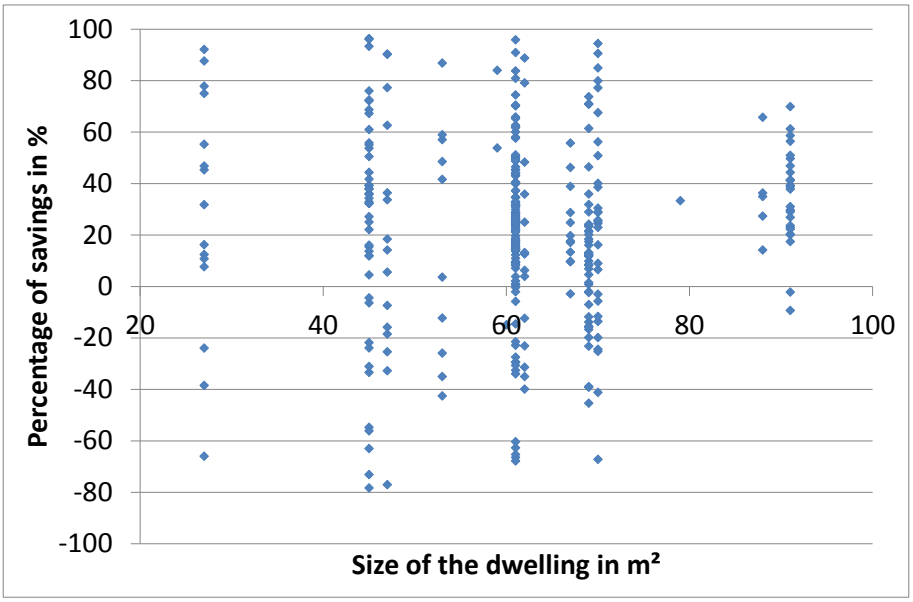
Figure 4-103: Annual hot water consumption (in m3/person) related to the surface of the dwelling in m², in 2012



Further it is interesting to study the relation between the percentage of savings and the size of the dwelling. The following graph shows that a majority of the dwellings (76%) achieved savings. This

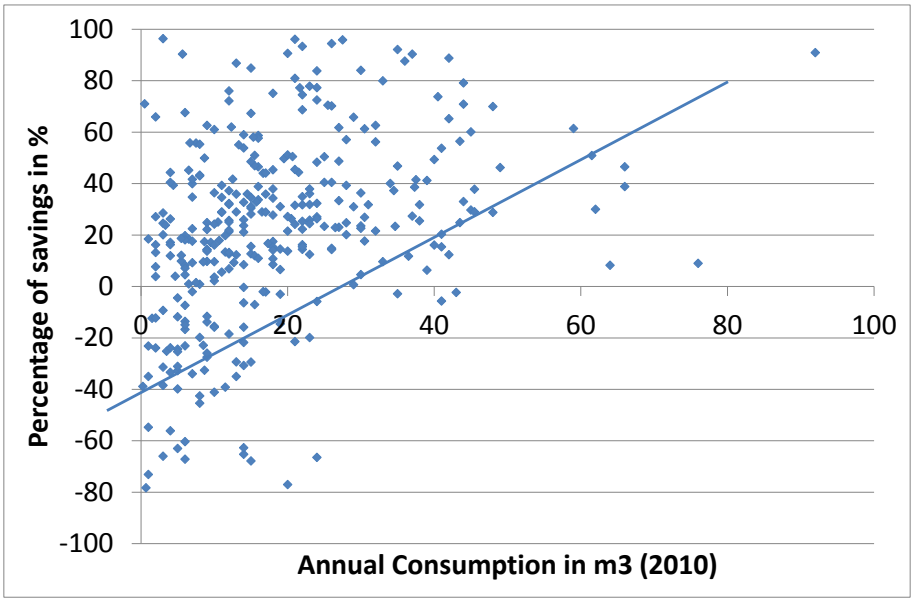
graph also highlights the good results of smaller dwellings compared to the large dwellings (surface around 90m²).

Figure 4-104: Percentage of savings (+ values) related to the surface of the dwelling in m²



To follow, the surface of the dwelling can be replaced by the annual consumption of the baseline period. In doing so, the following figure shows the tendency (marked with the trend line) that high consumers achieved higher percentages of DHW savings than the low consumers.

Figure 4-105: Percentage of savings (in %) related to annual hot water consumption in m3/people



Cold Water

As for hot water it is important to relate the level of annual consumption to the number of persons living in the dwelling. Again the graphs below describe a global decrease of cold water consumption.

Figure 4-106: Annual cold water consumption (in m3/person) related to the surface of the dwelling in m², in 2010

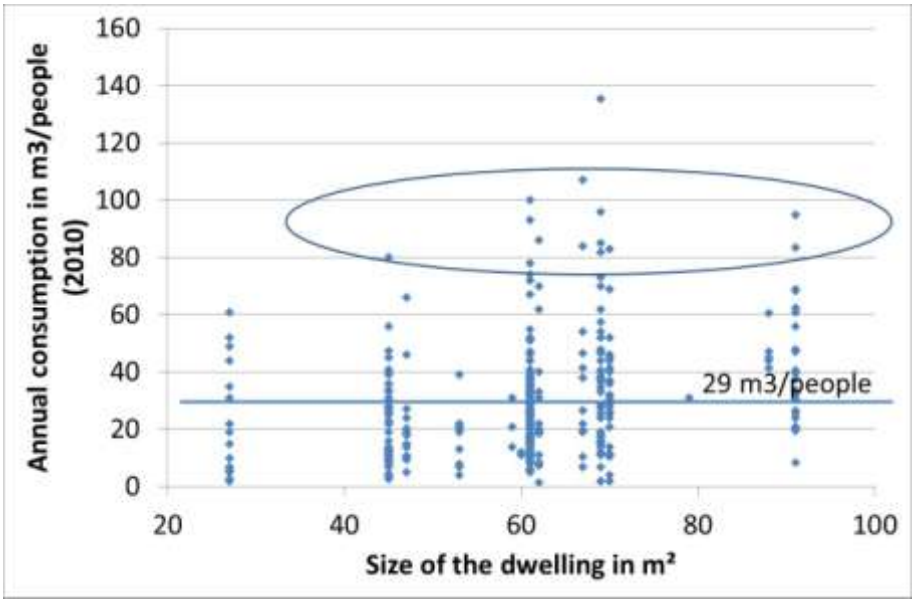
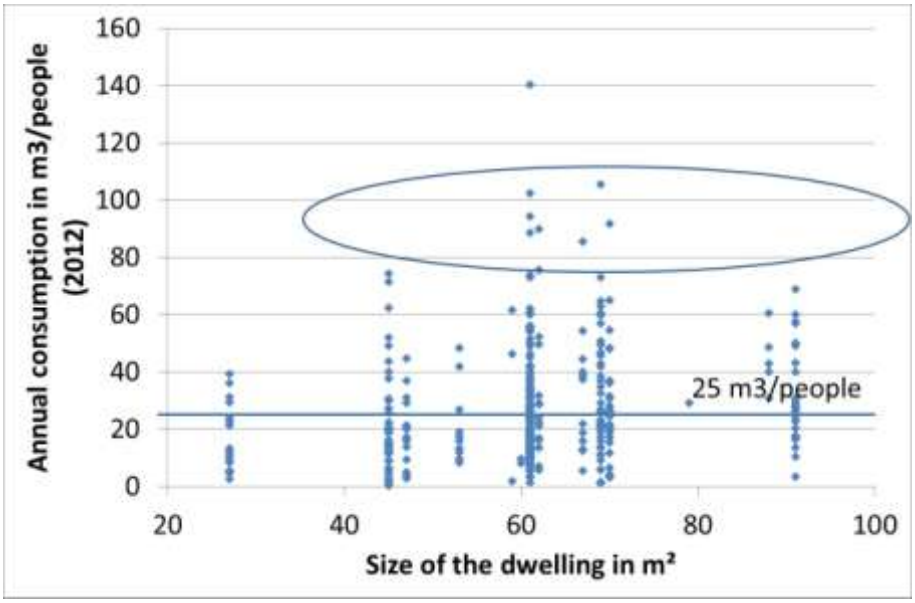
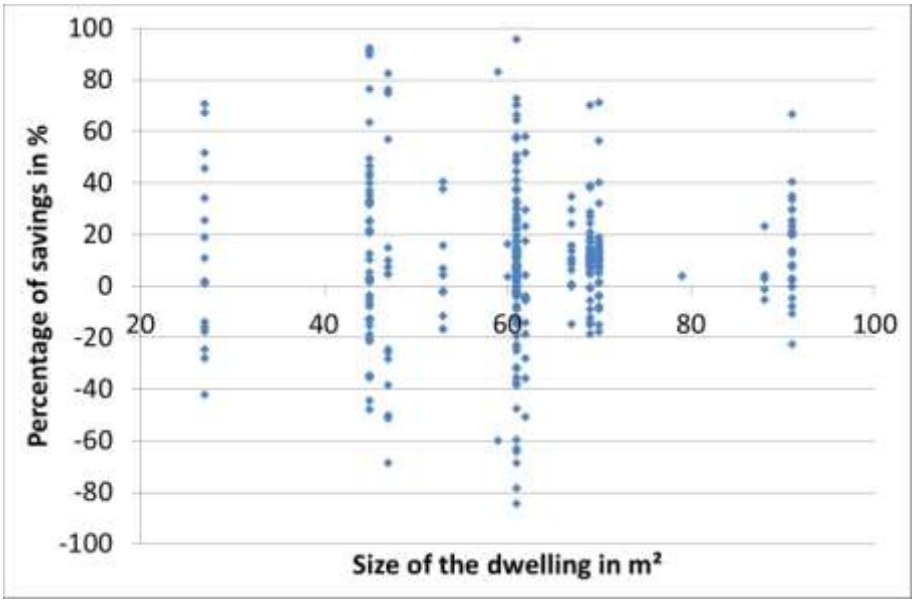


Figure 4-107: Annual cold water consumption (in m3/person) related to the surface of the dwelling in m², in 2012



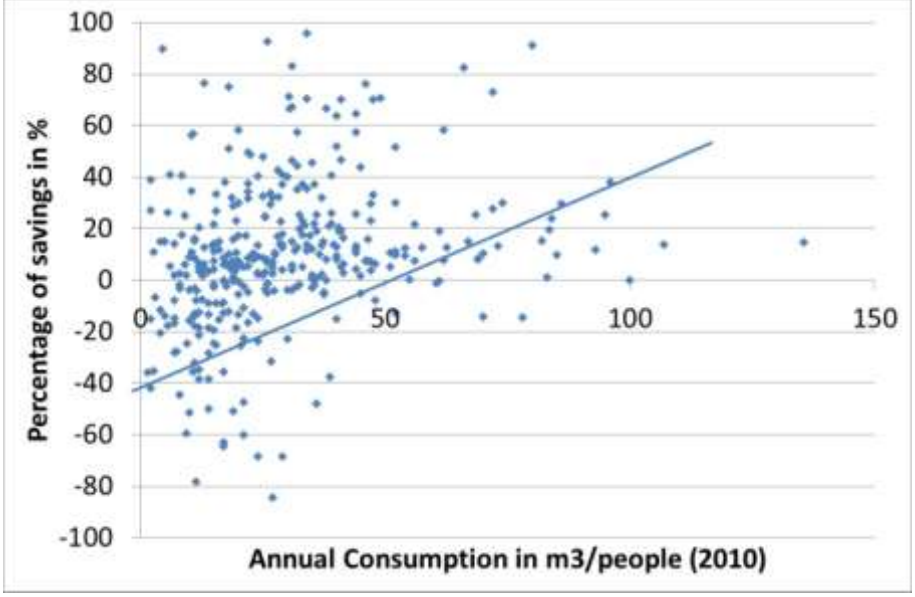
When studying the relation between the percentage of savings and the size of the dwelling, it appears that nearly 70% of the dwellings made savings. As the following figure further shows are middle-sized dwellings mostly involved in these savings.

Figure 4-108: Percentage of savings (+ values) related to the surface of the dwelling in m²



In the following the surface of the dwelling has been replaced by the annual consumption of the baseline period. As for DHW, can be observed that there a slight tendency of high consumers to make more savings than low consumers.

Figure 4-109: Percentage of savings (+ values) related to annual cold water consumption in m3/person



Comparison between users and non-users of the service

The comparison of EAS users and non-users shows, that, in the case of hot water, 80% of the users and 70% of the non-users achieved savings. Regarding cold water the percentages are very similar.

Table 4-58: Distribution of users and non-users in the consumption dataset & Results

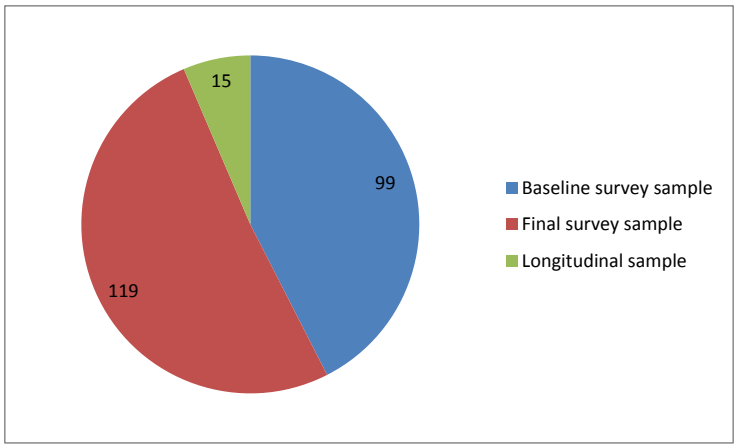
Comparison between users and non-users					
		Hot water		Cold water	
Total of dwellings	Users	193	56%	193	55%
	Non Users	149	44%	155	45%
	Total	342	100%	348	100%
Surface per dwelling	Users	63,98		63,59	
	Non Users	57,55		57,74	
People per dwelling	Users	1,44		1,45	
	Non Users	1,45		1,45	
Average Annual Consumption 2011 (baseline period)	*Unit*	*m3/(dw.year) in 2011*		*m3/(dw.year) in 2011*	
	Users	26		41	
	Non Users	19		37	
%of dwellings which made savings	Users	80%		66%	
	Non Users	70%		71%	
	Total	76%		70%	

An explanation for that result provides the view on the average annual consumption of both groups during the baseline period. For hot water it is shown that the level of consumption of the user was high compared to the level of the non-users, whereas in the case of cold water both groups had a similar level of consumption.

4.7.3 Results of tenant survey analysis

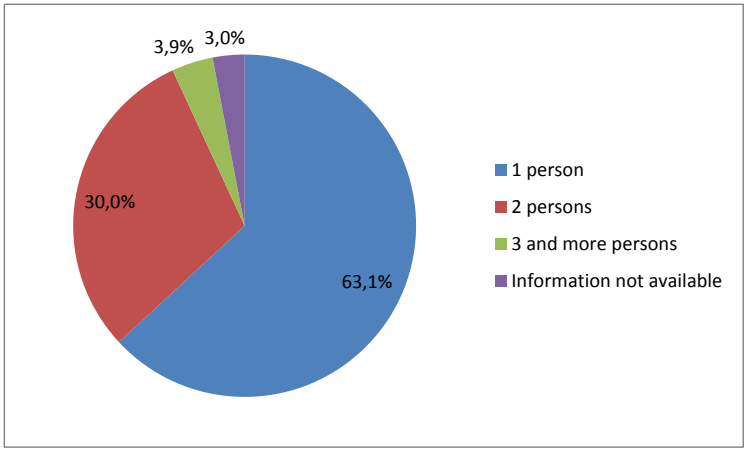
In Moulins two tenant surveys have been carried out – the baseline survey in October to December 2011 and the final survey at the end of the reporting period in December 2012/ January 2013. In total, 233 tenants (49% of the total pilot sample) participated in at least one stage of the survey. Thereof 15 tenants participated in both survey stages.

Figure 4-110: Overview of sample sizes in Moulins



From the 134 tenants participated in the final survey is known that most of them live in single households (63%) and two-persons-households (30%).

Figure 4-111: Household size of tenants participated in the final survey



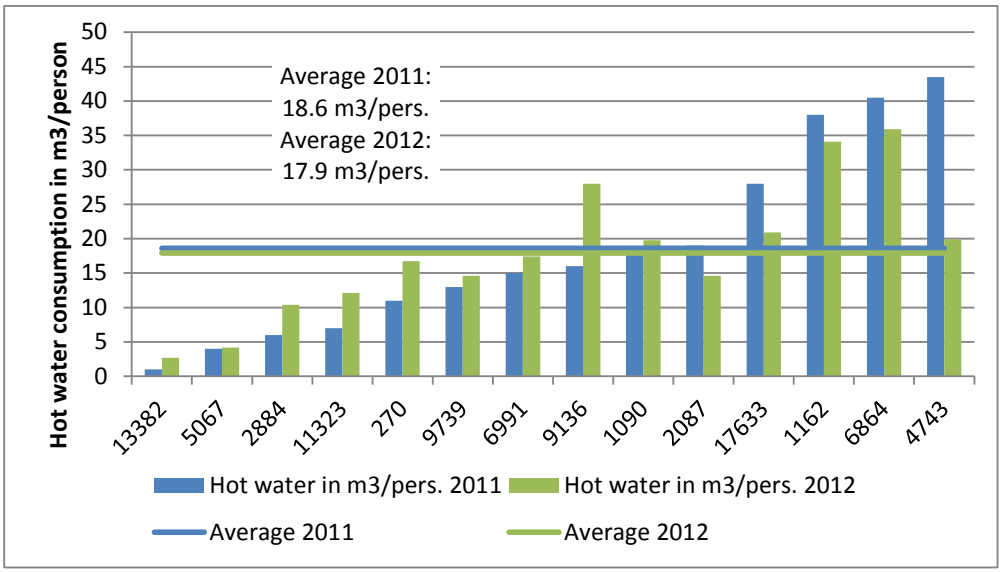
Both surveys mainly contained questions about energy consumption behaviour patterns and energy saving attitudes of the pilot tenants. Especially the baseline survey focused on detailed reports on heating and ventilation behaviour. The foreseen in-depth exploration also in the final survey was postponed to another survey in the future, because the current eSESH EAS didn't present feedback on heat energy consumption and no measurements were available due to the above given reasons.

Therefore in the following the (hot) water consumption shall be focussed in view of the fact that water consumption is already measured and provided to the tenants via EAS and can be compared with tenant survey data. Findings related to heating and electricity consumption behaviour will be reported roughly only. As described above, Moulins Habitat will continue the work on EAS which will include also electricity and heat energy consumption information in the future. In that context the pilot site plans to carry out further tenant surveys in order to identify expected behavioural changes compared to the baseline information gathered in the eSESH tenant surveys.

Results of the longitudinal study (n=15)

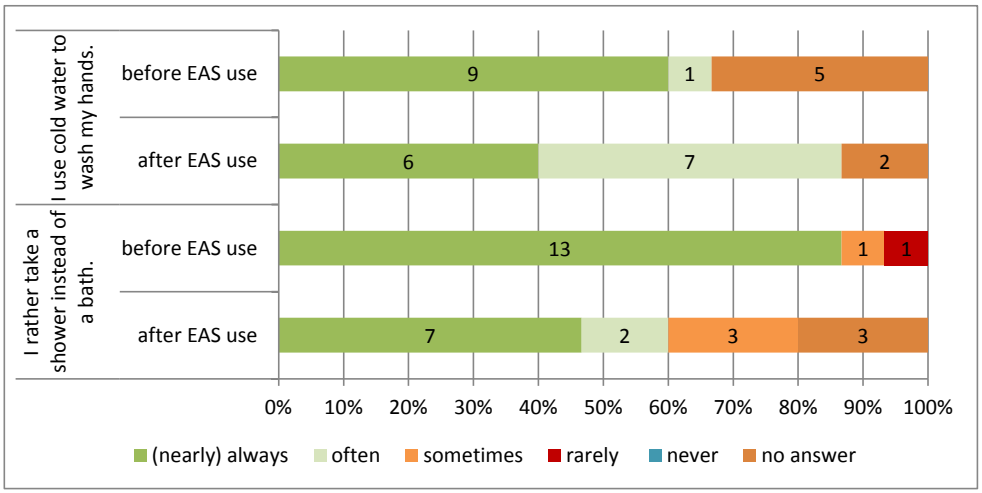
Due to the small sample size of 15 tenants belonging to the longitudinal study the following result presentation is restricted. Nevertheless, the results show first good trends as 4% total savings of domestic hot water (DHW) have been achieved in that group within the project duration. The high consumers (tenant ID: 17633, 1162, 6864, 4743) achieved very good DHW savings from 10% up to 54 %.

Figure 4-112: Pre-post comparison of DHW consumption in m^3/person in the longitudinal sample (n=14)



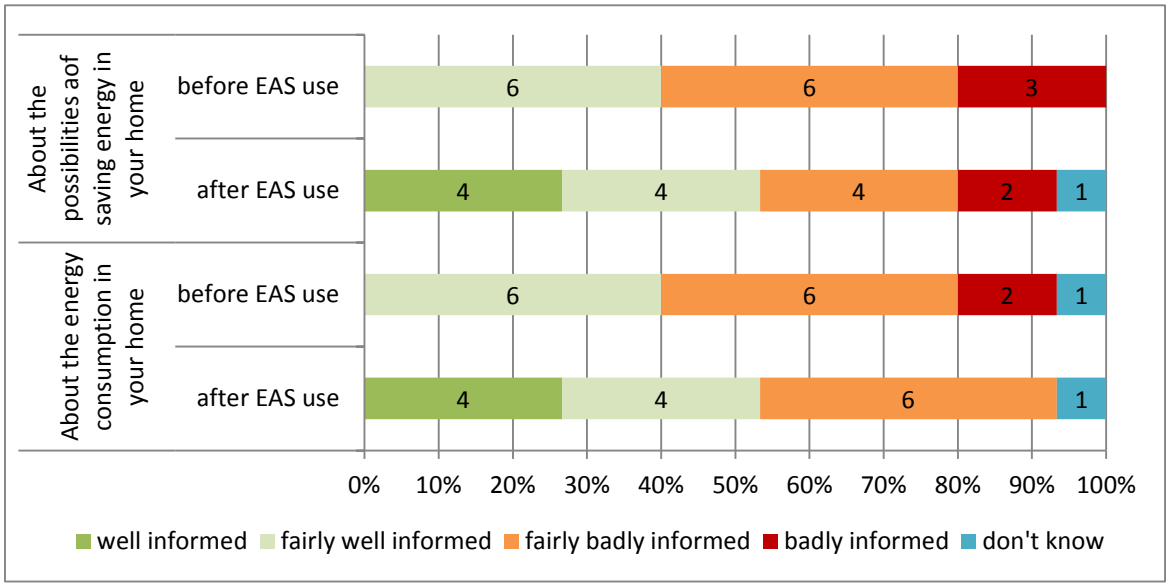
Hot water is used for several purposes. The questionnaire focussed only on two of them. But the above described savings results are very likely influenced by the fact that the tenants of the longitudinal sample now more often use cold water to wash their hands. Even though the number of tenants who reported on rather taking a shower than a bath decreased in the pre-post comparison, it is to assume that they reduced the showering time or installed water-saving taps.

Figure 4-113: Pre-post comparison of reported hot water consumption behaviour in the longitudinal sample before and after EAS use (n=15)



The reported information levels about water consumption at home and the possibilities to save it slightly increased after EAS use. Now 8 of the 15 tenants feel (fairly) well informed compared to six fairly well informed tenants in the baseline survey. Four tenants feel now well informed about their possibilities to save water, two of them belong to the four 'high consumer'.

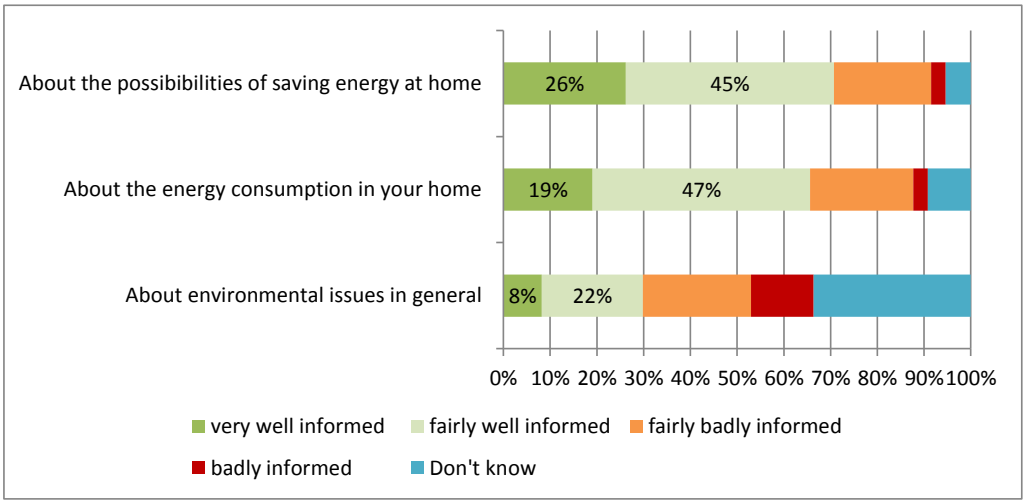
Figure 4-114: Before-after comparison of information level reported in the longitudinal sample (n=15; total number of respondents)



Results of the final survey (n=134)

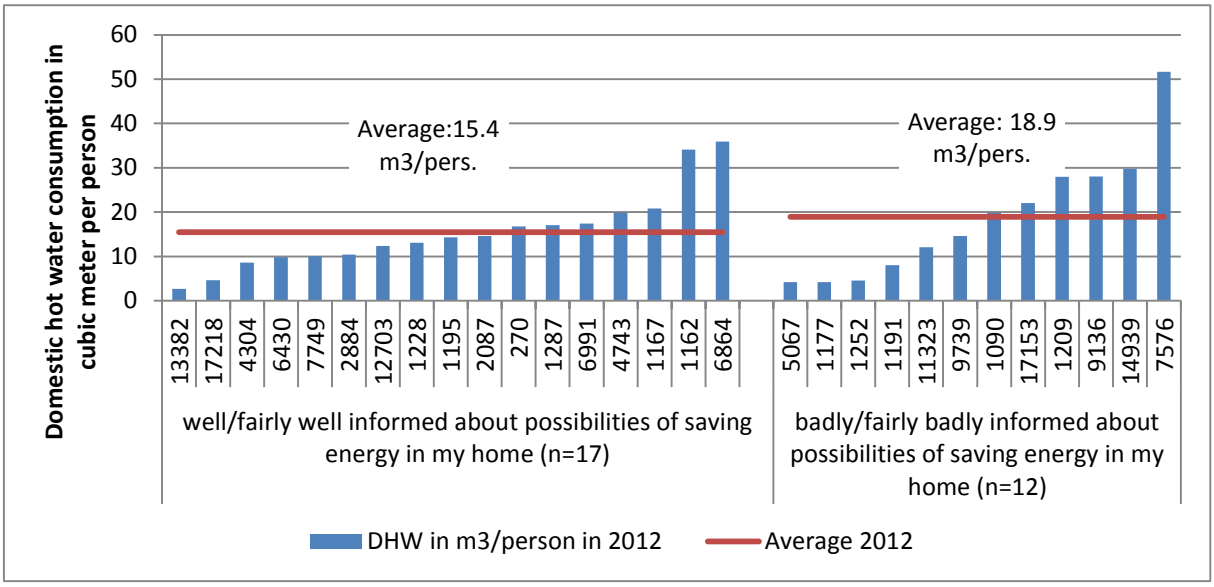
Related to the total final survey sample the following figure shows that most of the respondents reported on a good knowledge about the possibilities of saving energy at home and about their energy consumption at home. Nevertheless, about one quarter resp. one third of the tenants described knowledge gaps. 21% of the final survey respondents had the opinion that their today's energy consumption is (very) high which can be interpreted as a first step on the way to awareness-raising. Half of them still reported on insufficient information levels.

Figure 4-115: Level of information regarding… (n=134)



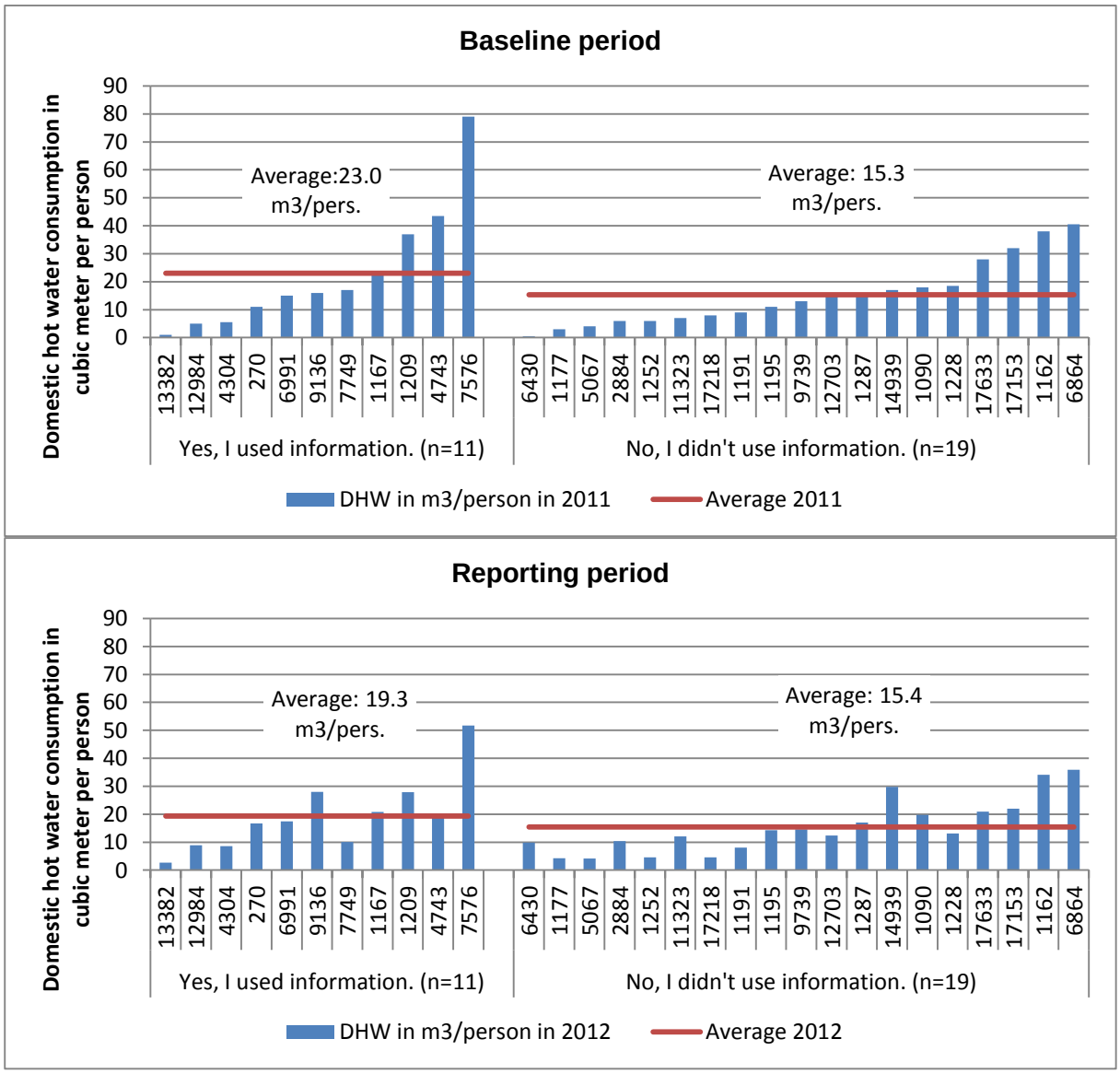
Those tenants who feel sufficiently informed about the possibilities to save hot water have a 19 % lower hot water consumption per person than tenants who felt (fairly) badly informed.

Figure 4-116: DHW consumption differentiated by information level



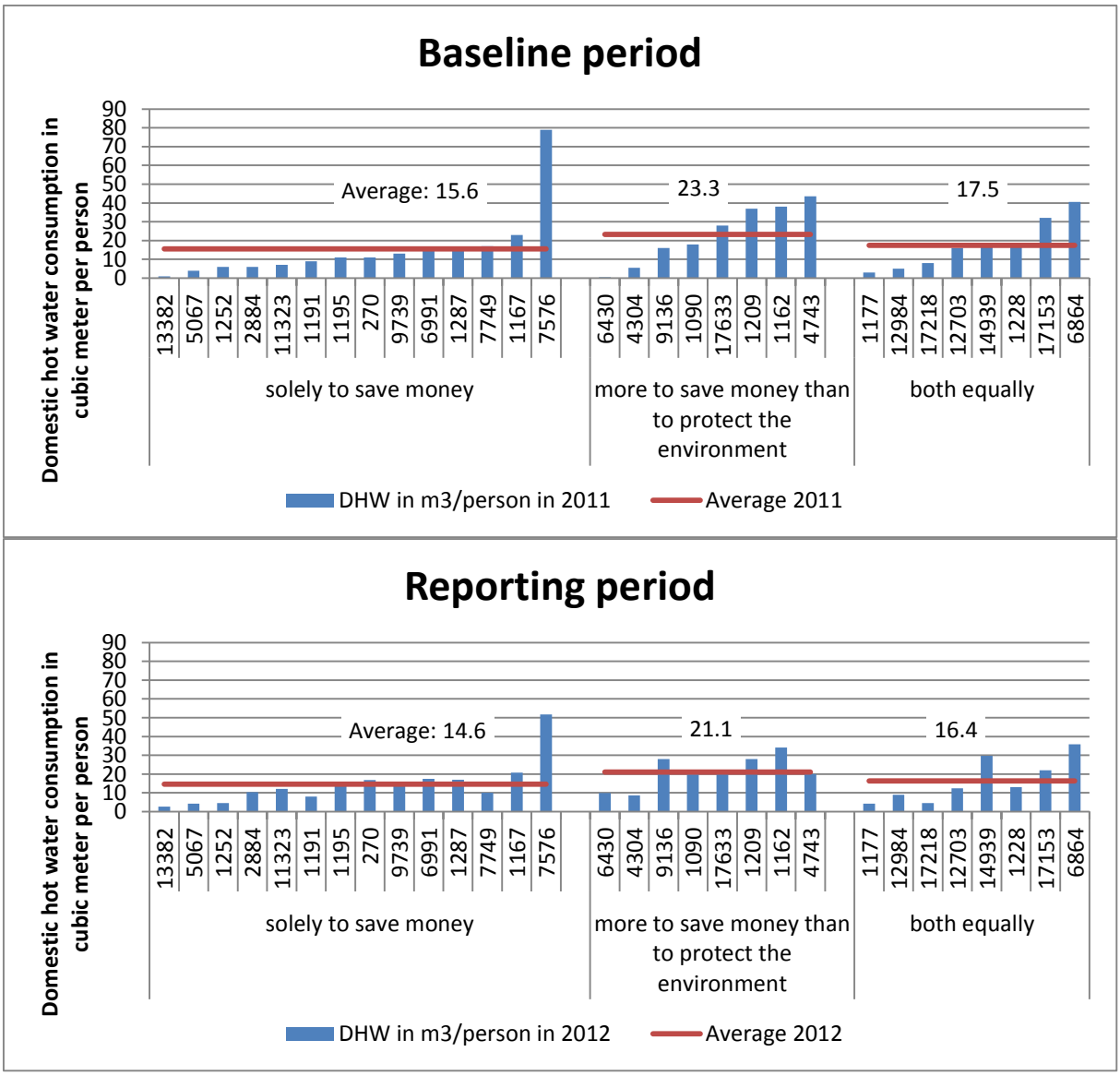
Especially tenants with comparably high water consumption were interested in information about how to save resources. Those tenants, who used water saving information from the EAS as well as from other sources (see above described incentives) reduced their water consumption by 16% in the reporting period compared to the baseline period. The consumption of the other group without demand for further information stayed unchanged in the course of time. That demonstrates the big impact information level has on energy saving issues.

Figure 4-117: Pre-post comparison of hot water consumption of tenants who used saving tips compared to those who didn't use such information



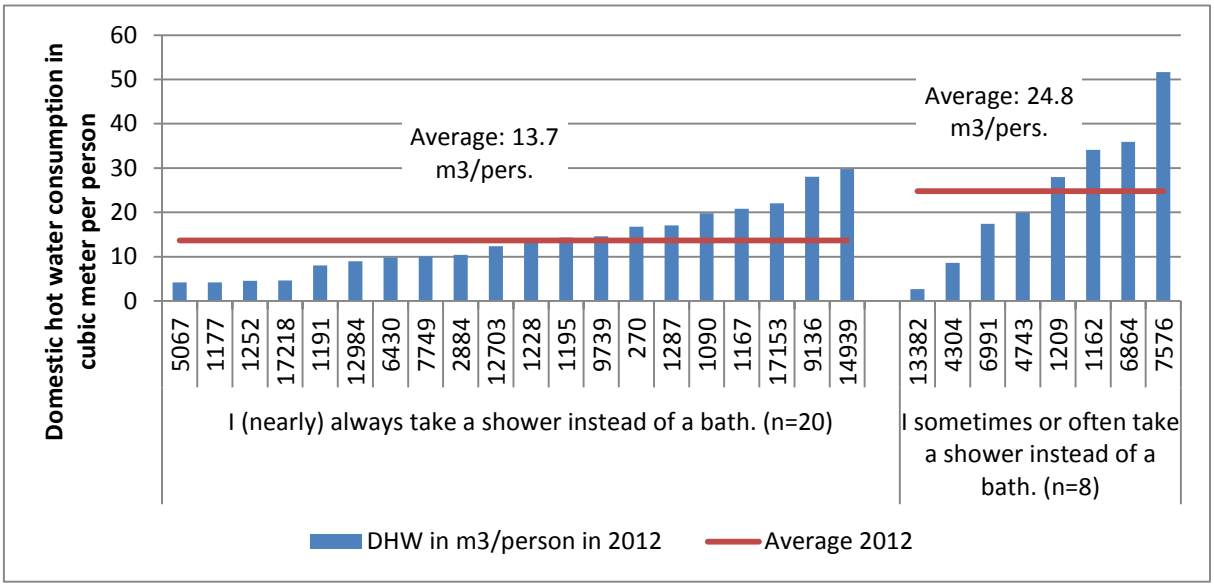
The motivation why tenants want to save hot water – solely to save money or also to protect the environment – is independent from the achieved savings. As the following figure shows, all tenants with measurements achieved savings in a range from 6% up to 9% in the reporting period. Nevertheless, those tenants who need to save money have lower average consumption than others also interested in environmental protection.

Figure 4-118: Hot water consumption data of tenants who were motivated to save energy due to solely save money or due to protect the environment



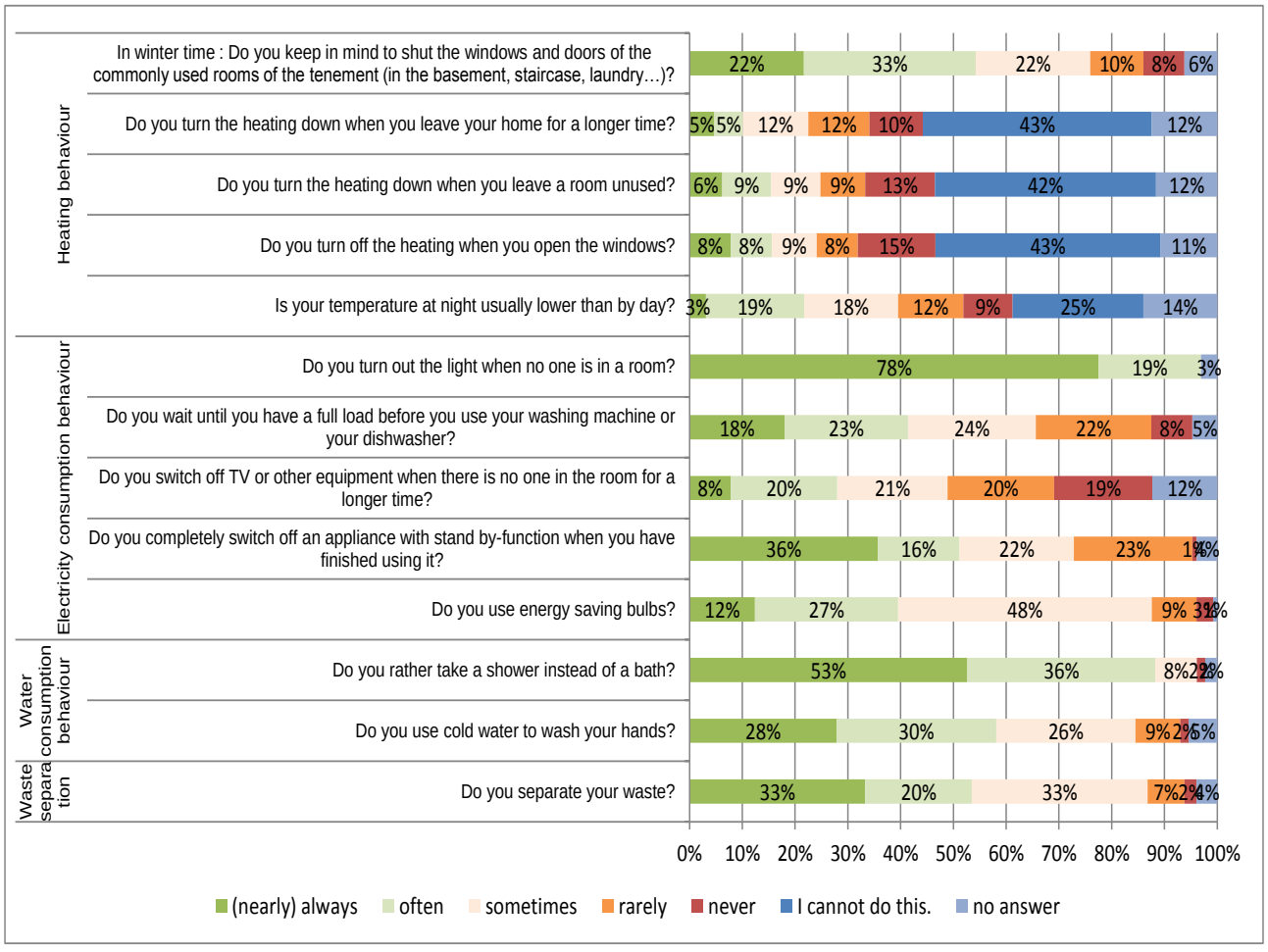
Nearly half as large was the consumption of those tenants who reported on (nearly) always taking a shower instead of a bath compared to those who do that more seldom.

Figure 4-119: Hot water consumption differentiated by preference of showering instead of bathing



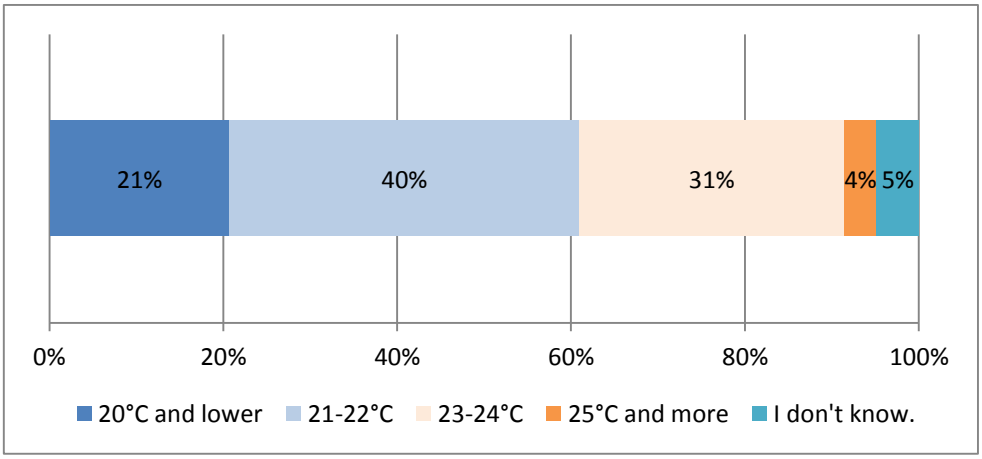
In general, 53% of the final survey reported on (nearly) always taking a shower instead of a bath. Further 36% of respondents do that often.

Figure 4-120: Everyday consumption behaviour (final survey, n=129)



As the above figure further shows nearly half of the respondents cannot regulate the heating by itself. 61% of those respondents who are able to regulate the room temperature by themselves chose indoor temperatures up to 22°C which can be seen as optimum temperatures. One third of the respondents felt comfortable with higher room temperatures in winter. That finding probably describes a potential for savings.

Figure 4-121: Reported winter indoor temperatures (n=44, only respondents who can regulate the heating by themselves)



Saving potential can also be found with regard to the electricity consumption. Except turning off the lights when leaving a room, which is reported from nearly respondents, there are several saving potentials obvious in the above figure.

As already stated above, electricity as well as heat energy consumption will be focussed in the relaunch of the EAS service. In that context further tenant surveys are planned focussing on the question if the EAS is an appropriate instrument for tapping these potentials.

Regarding water consumption can be summarised that the impact if EAS is promising: Those respondents with water measurements who were interested in saving information achieved DHW savings of 16%. That is especially positive to assess because those tenants often belonged to the group of ‘high consumers’.

4.8 Solingen

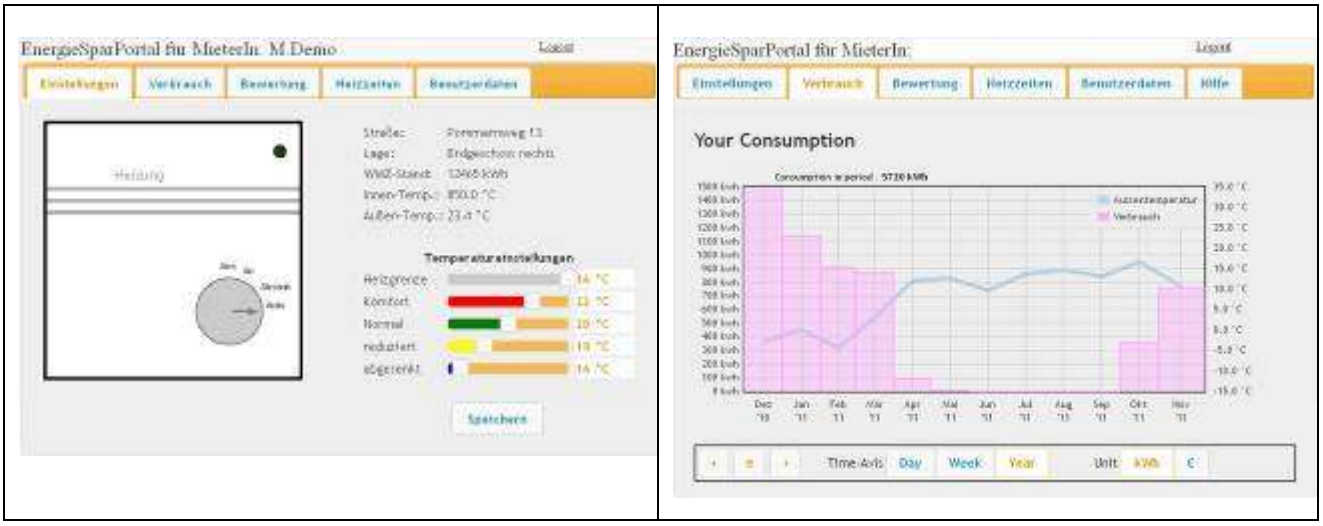
4.8.1 Background information

The Solingen eSESH service provided to the pilot tenants is an EAS web-portal which includes the following two main components:

1. According to their attendance time and their preferred day and night temperatures the tenants can manage their indoor temperatures on different comfort levels. The core part of the service is a central motor valve which interrupts the heating supply of the dwelling completely if it is closed. This motor valve is connected to a controller which closes the motor valve automatically if the desired indoor temperature is reached.
2. In addition to that the tenants receive consumption feedback - current heat energy consumption figures as well as reference values for the purpose of comparisons.

SBV (Solingen social housing company) used a central EMS based on heating settings of EAS and gives several opportunities to regulate the mode of operation of the heating system.

Figure 4-122: Screen shot of the EAS web portal (left: indoor temperature regulation for several, right: consumption feedback)



In order to inform and invite tenants to use the offered EAS the tenants received several information materials and could participate in two tenant events (April 2011 and January 2012). A first training for using the EAS was made via telephone. A second training session for users took place in the January 2012 meeting. Those tenants who were not interested in EAS use could ask SBV staff to operate the EAS on their behalf and optimise parameter settings aiming at balanced and optimal energy consumption. For the SBV staff three trainings took place within the period between April 2011 and December 2011. One SBV staff member working as 'carer' and dealing with failures or tenant complaints was additionally trained in December 2011 and January 2012.

In total, 296 dwellings in 31 buildings were involved in the pilot. Thereof 189 tenants make more or less regularly use of the eSESH service which equates to 64% of the total number of pilot tenants.

Table 4-59: Overview of the number of buildings and dwellings involved in the Solingen pilot

Site	Pilot site name	Number of buildings involved	Number of dwellings involved
Solingen	Pommernweg	31	296

The first version of the tenant portal was developed prior the eSESH project. That version only served for regulating the heating settings. The optimised eSESH EAS service with further functionalities (as above described) was implemented in April 2011.

4.8.2 Results of consumption data analysis

Global results of heating analysis (EMS)

The pilot settlement Pommernweg has been refurbished prior to the eSESH project. In that context already the first version of the EAS tenant portal (above described heating setting by internet portal) could be used by the residents in order to define their preferred indoor temperature at day and at night. The so received information on tenant comfort temperature levels have been used by SBV staff for optimisation of the mode of operation. By knowing when heating is needed it was possible to adjust the heating system demand-oriented. That led - for example - to a complete interruption of the whole heating grid in nights (between 23 and 5 o'clock) with an outdoor temperature higher than 12°C[14]. These settings set by the central EMS are in most cases below the temperature settings in place before eSESH service introduction which were set by the tenants individually and typically at higher levels. Tenants now wanting to deviate from this setting today have to call the call centre to change EMS settings.

A comparison of a period without eSESH service use and a period with service use turned out to be not possible since all the previous years prior to the eSESH project have been a period of re-construction, refurbishment and insulation of the building in the pilot site and the replacement of the individual gas heating systems by a central heating system based on a wood chip boiler with nearly zero CO2 emissions related to primary energy and compared to the gas system. For those refurbishments the German Energy Saving Ordinance (EnEV) stipulates standard technical requirements for efficient energy use in residential and non-residential buildings. Even though a before-after-comparison is not useful, a comparison with similar settlements following a control group approach have been carried out. To put the energy use and savings after the introduction of the eSESH EMS and EAS in a wider context Solingen compared the energy consumption figures of the eSESH pilot site in 2011 and 2012 to comparable neighbourhoods of buildings which had been refurbished in the same way as the eSESH pilot site buildings but are not using the eSESH EMS and EAS.

The following table shows the comparison of heat energy demand figures regulated in EnEV and measured heat energy consumption in three similar constructed and refurbished settlements in Solingen. The difference between the pilot site Pommernweg and the both remaining settlements

[14] A heating limit temperature of 12°C is comparably low. Normally 15°C is taken into account related to the German building stock.

is the automatic temperature lowering at night which is based on the information gathered with the EAS and which is only realised in the eSESH pilot site[15].

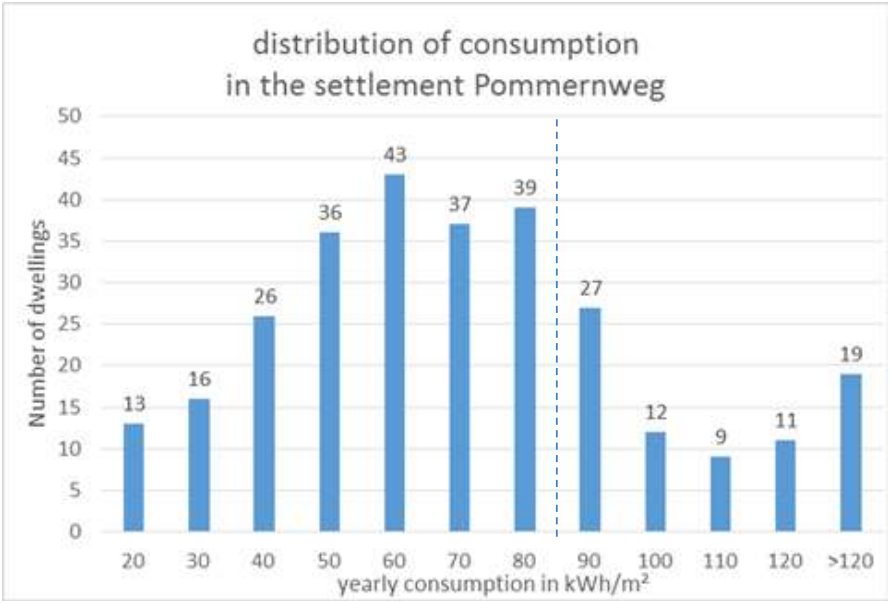
Table 4-60: Comparison of heat demand (EnEV) and measured heat energy consumption in three similar settlements (Glockenstraße, Maltesergrund without and Pommernweg with night lowering)

Settlement	Size related to EnEV (m^2)	Heat energy demand related to EnEV (kWh/m^2*a)	Measured heat energy consumption (kWh/m^2*a)	Percentage of deviation
Glockenstraße	3,087	65.38	70.17	+7%
Maltesergrund	2,068	67.13	82.92	+24%
Pommernweg	22,885	64.25	55.00	-14%

Compared to the heat demand specified in EnEV the pilot site Pommernweg achieved a much better performance with a 14% lower heat energy consumption (55 kWh/m^2*a) than the calculated heat demand (64 kWh/m^2*a). That result is even more positive when comparing it with the similar settlements which don't fit the calculated heat demand of EnEV. That comparison shows savings of 21% up to 38% which underlines the success of the eSESH EAS and EMS without which this positive result would not have become achievable.

As the distribution in the following figures shows only 78 of the total number of 296 dwellings has a measured consumption which is higher than the calculated EnEV heat demand.[16]

Figure 4-123: Distribution of heat energy consumption in the pilot site Pommernweg



Compared to the energy savings target of 15% less heat energy consumption the above described result is a success.

[15] Another difference is that Pommernweg is heated by a wood chip boiler while both sites of the control group are heated by gas.

[16] The EnEV uses a simplified standardised estimation model for the inclusion of surface areas in the heat demand calculation which is deviant from the calculation related to 'real' dwellings sizes. By converting the EnEV values into 'real' net dwelling areas the heat demand will become higher. In the case of Pommernweg that value is 79 kWh/m^2*a.

Global results of heating analysis (EAS)

As described above in the eSESH context the already existing EAS has been further developed. Besides heating settings tenants now have the additional possibility to receive heat energy consumption feedback on a monthly basis linked to several reference parameters (previous consumption, averages, etc.).

Before analysing the heating data, it was necessary to cleanse it in order to take into account the change of tenancy as well as some incoherencies or periods of absence of the tenants. In those cases the dwellings were excluded from the data analysis. As the following table shows, 166 of the total number of 296 pilot dwellings have been analysed. That equates 56% of the whole dataset.

Table 4-61: Description of the cleansing step

Cleansing			
Data	Site	Number of dwellings	
		Before cleansing	After cleansing
Heating	Total	296	166

For calculating the savings a pre-post comparison has been used. The pre-post comparison is based on the analysis of the evolution of the heating consumption before and after the implementation of the service. In view of the eSESH service start in April 2011, the baseline period covers the months 01/06/2010 – 31/03/2011, the reporting period the time period 01/04/2011–31/12/2012.

As the following figure as well as the overview table show, the consumption of pilot tenants stayed more or less unchanged in the pre-post-comparison. There is a slight increase of 1% heat energy consumption obvious. However, as the above discussed results showed, the Solingen pilot tenants consume much less than tenants live in similar settlements and much less than the calculated heat demand. In addition to that a high percentage of respondents in the tenant survey (see below) reported on optimal heating and ventilating behaviour and comparably low indoor temperatures. That implicates that the possibilities of the Solingen pilot tenants to achieve further heat energy savings are very limited.

Figure 4-124: Annual consumption in kWh (HDD Corrected Values) in 2009, 2010 and 2011

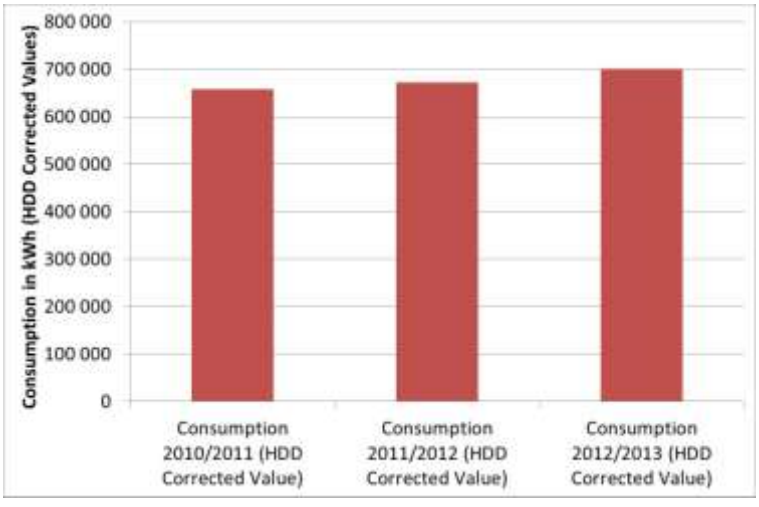


Table 4-62: Overview of global results in Solingen (EAS)

Key data	
	Heating
Number of dwellings	166
Surface area (average)	63
Number of people (average)	-
Global Results for the dataset of dwellings	
	Heating
Savings (%) - eeMeasure (weighted)	-1,20%
Saving (kWh/yr or m3/yr) - eeMeasure	-
Carbon Dioxid Reduction in kgCO2/yr - eeMeasure	-
Financial Saving (€/yr) - eeMeasure	-
Consumption Before Intervention (kWh/yr - average)	633 794
Results per dwelling or per people	
	Heating
Consumption Unit	*(kWh/m².year)*
Consumption - Before intervention (annual average)	61
Consumption - After intervention (annual average)	60
Consumption Unit	*(kWh/m².year)*
Consumption - Before intervention (annual average)	61
Consumption - In the same country* (annual average)	162
Saving (kWh/dwelling.yr or m3/dwelling.yr)	-
Carbon Dioxid Reduction in kgCO2/dwelling.yr	-
Financial Saving (€/dwelling.yr)	-
** See references*	

Even if there is a slight global increase obvious, the two following charts containing the evolution of the annual consumption (in kWh/m²) before and after the implementation of the service can show that the amount of 'high consumers' is decreasing.

Figure 4-125: Annual Consumption (in kWh/m²) related to the surface of the dwelling in m², in 2009

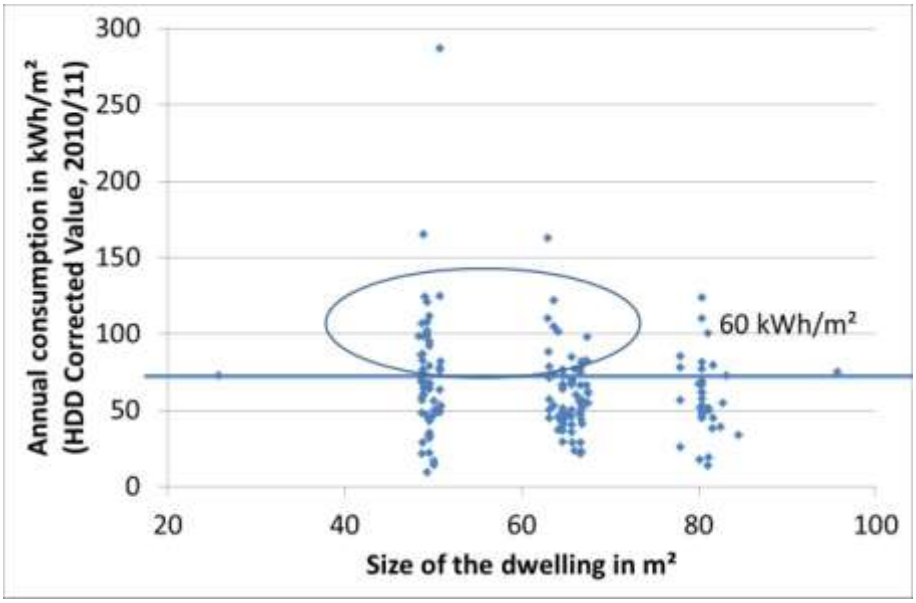
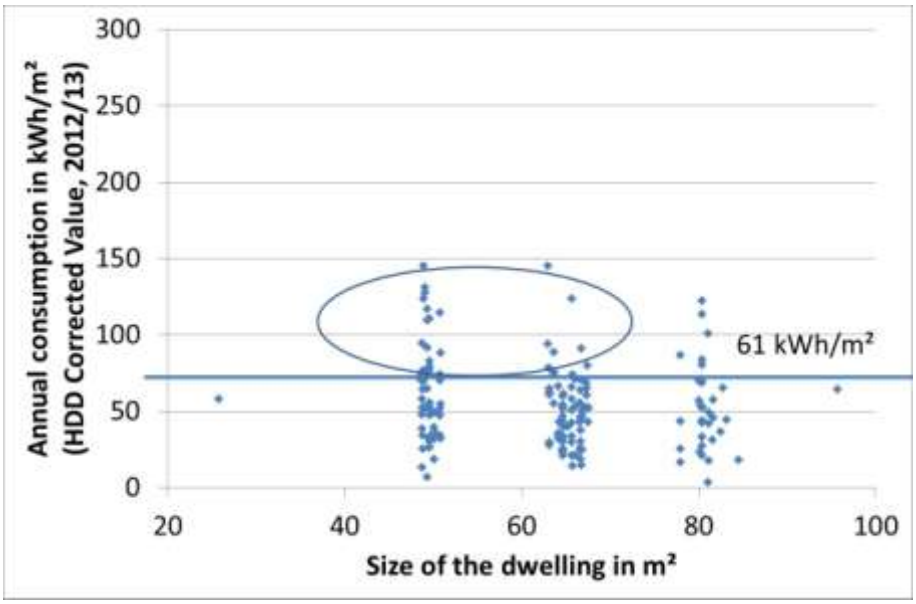


Figure 4-126: Annual Consumption (in kWh/m²) related to the surface of the dwelling in m², in 2012

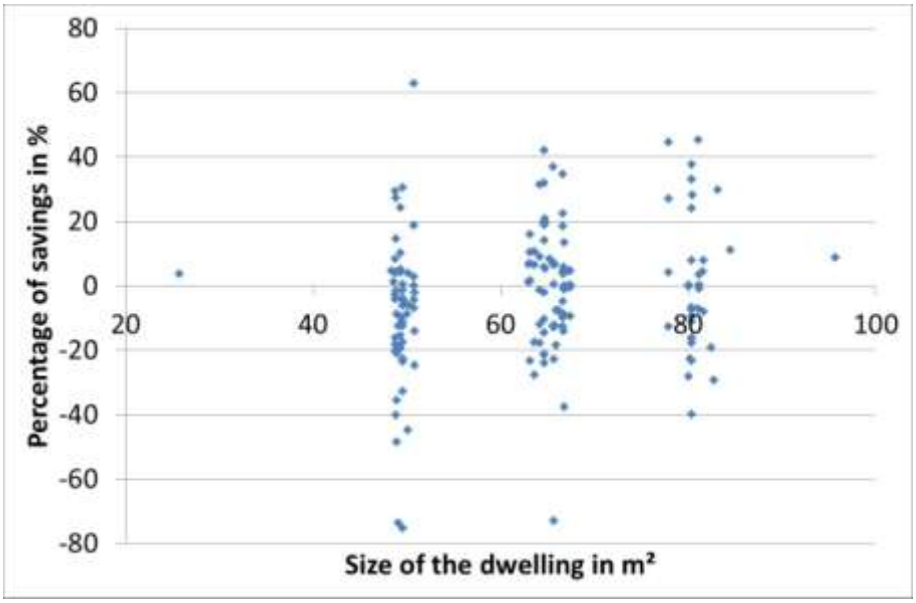


When studying the percentage of savings related to the size of the dwelling (see following figure) it can further be highlighted that in total 47% of the pilot tenants actually achieved savings.

Besides, there is no correlation between the size of the dwelling and the possibility to make savings or not to be seen.

Lastly, it is useful to compare the average pilot level to the German national level. Indeed, the level of consumption in Solingen is less than the half of the German level (61 kWh/m².year compared to 162 kWh/m².year for Germany). This comparison explains again the difficulty to achieve further savings. The feasible savings are limited for tenants who already consume less than the national average.

Figure 4-127: Percentage of savings (+ values) related to the size of the dwelling in m²



Comparison between users and non-users

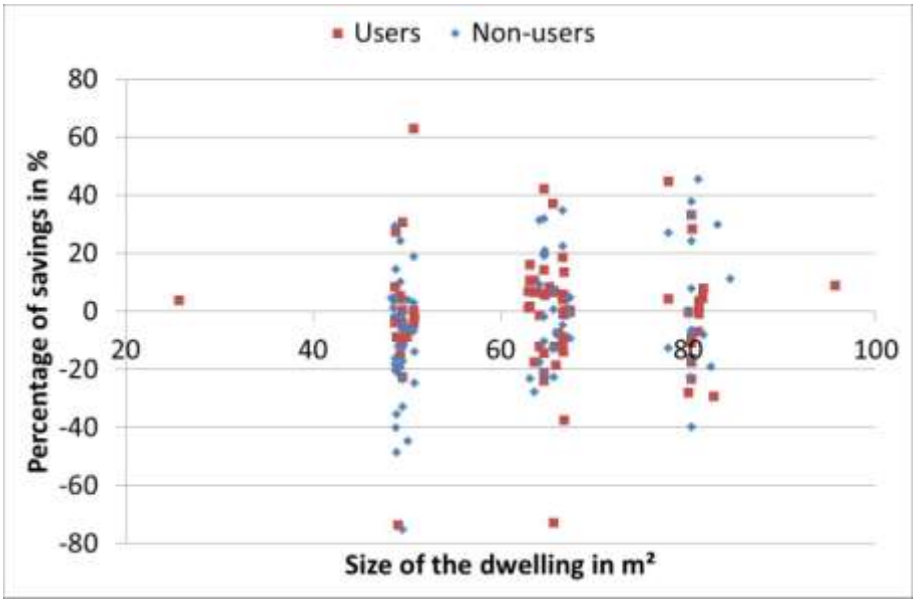
A positive impact of EAS can be stated when comparing EAS users and non-users. While users had a more or less unchanged consumption non-users had an increased consumption of nearly 3%. Nearly 60% of the users achieved savings, whereas this is equal to 38% of the non-users.

Table 4-63: Distribution of users and non-users in the consumption dataset and results

Comparison between users and non-users			
		Heating	
Total of dwellings	Users	88	53%
	Non Users	78	47%
	Total	166	100%
Surface per dwelling	Users	64,22	
	Non Users	61,75	
People per dwelling	Users	-	
	Non Users	-	
Average Annual Consumption 2011 (baseline period)	*Unit*	*kWh/(dw.year) in 2011*	
	Users	4215	
	Non Users	3374	
% of dwellings which made savings	Users	59%	
	Non Users	*38%*	
	Total	48%	
Savings (%)	Users	-0,20%	
	Non Users	-2,60%	

The following graph represents the percentage of savings per dwelling with a distinction between users and non-users.

Figure 4-128: Percentage of savings (+ values) related to the surface of the dwelling, for users and non-users



4.8.3 Results of tenant survey analysis

The Solingen pilot site carried out one cross-sectional tenant survey at the end of the reporting period in November/December 2012. In total, 41 of the 296 pilot tenants (14 %) participated in the survey.

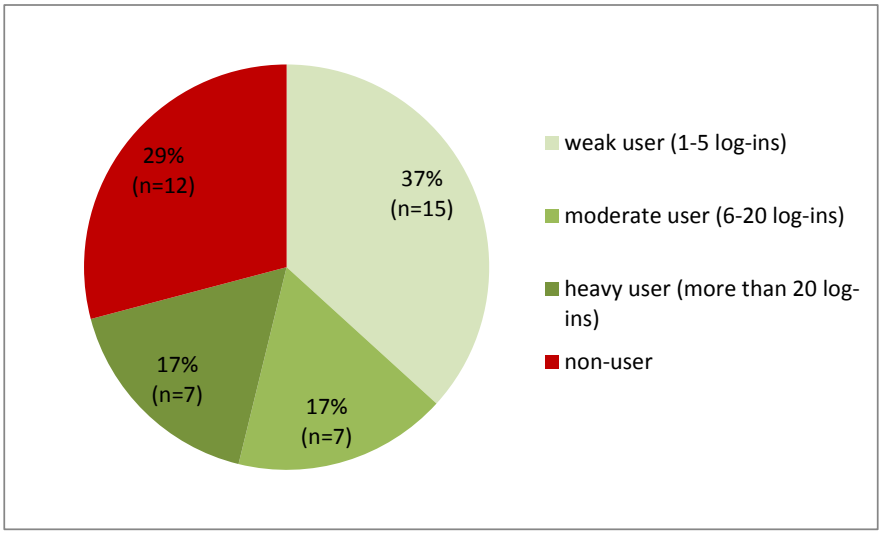
The survey focussed on ventilation and heating behaviour, reasons for EAS use and non-usage as well as user satisfaction.

EAS use and socio-demographic characteristics

Among the respondents of the 29 users of the tenant portal (71 %) who use the EAS more or less regularly[17]. The usage ranges from 1 up to 462 visits in the reporting period from May 2011 to December 2012. On average the respondents logged in for 42 times, which equates to log-ins two times a month. 12 respondents (29 %) do not use the EAS tenant portal.

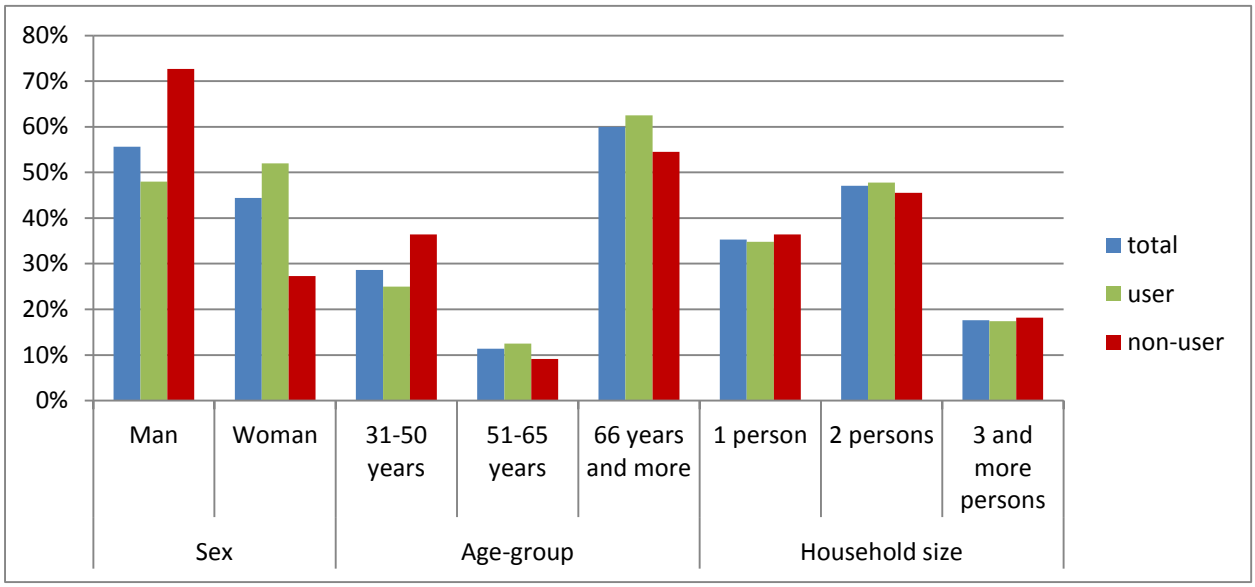
[17] That information bases on the measured portal log-ins.

Figure 4-129: Number of users and non-users of the EAS in the tenant survey sample of Solingen



Women are above-average interested in service use compared to men. The same slightly applies to those tenants who are more than 50 years old compared to younger respondents. The household size seems to be not a parameter.

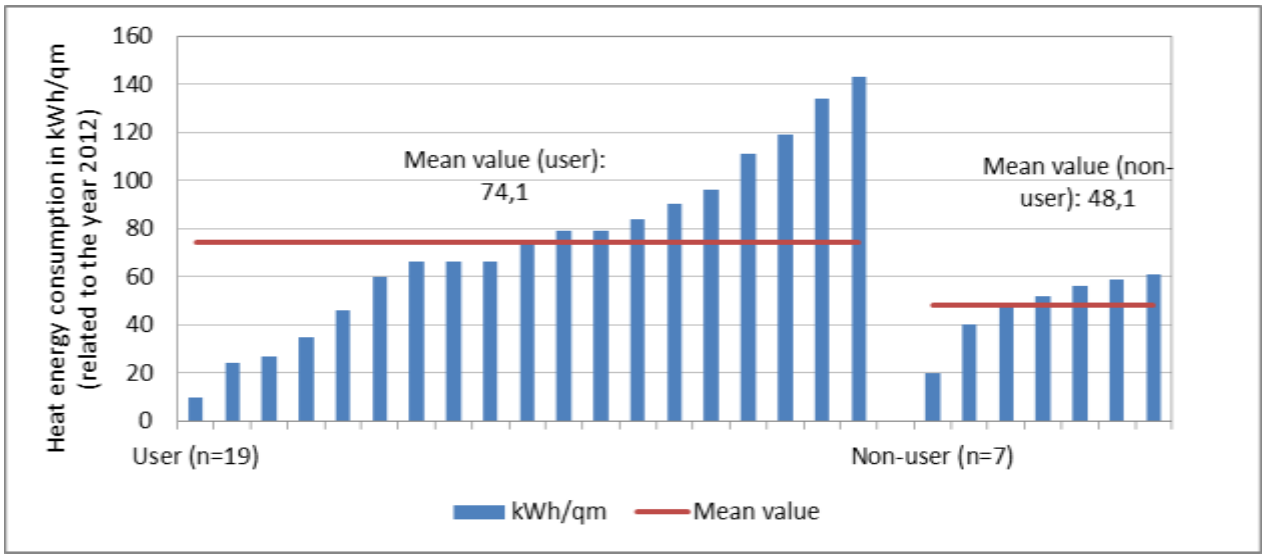
Figure 4-130: Sex, age and household size of respondents in total and by user/non-user



Reasons of portal use and its impact on knowledge and attitudes

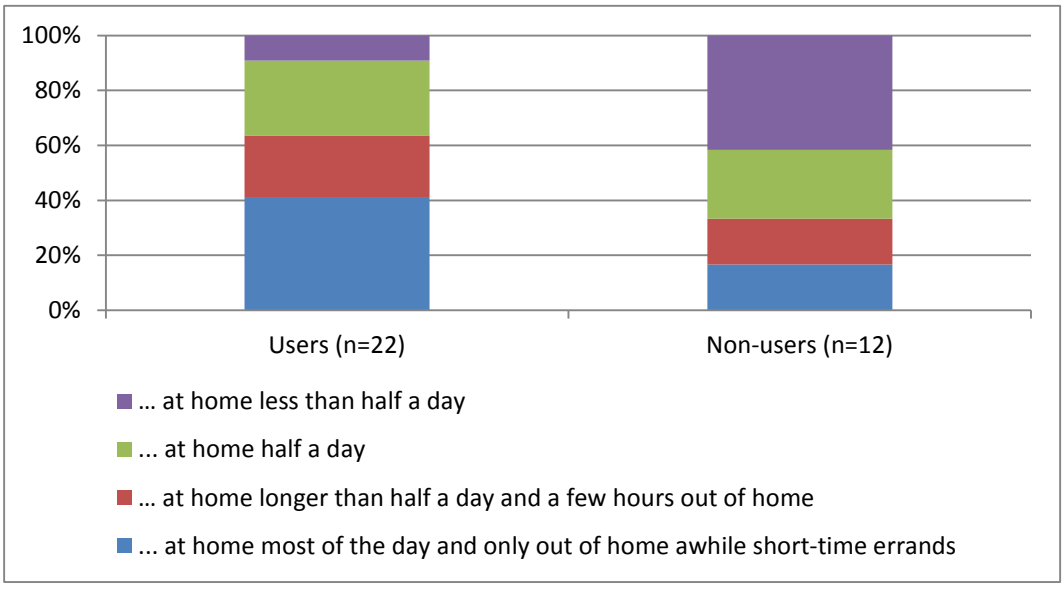
The portal use seems to be motivated by the self-assessment of the users to have comparably high heat energy consumption. Non-users had 35 % lower average heat energy consumption than the EAS users in the survey sample.

Figure 4-131: Heating consumption in kWh per m² of users and non-users of the survey sample (n=26)



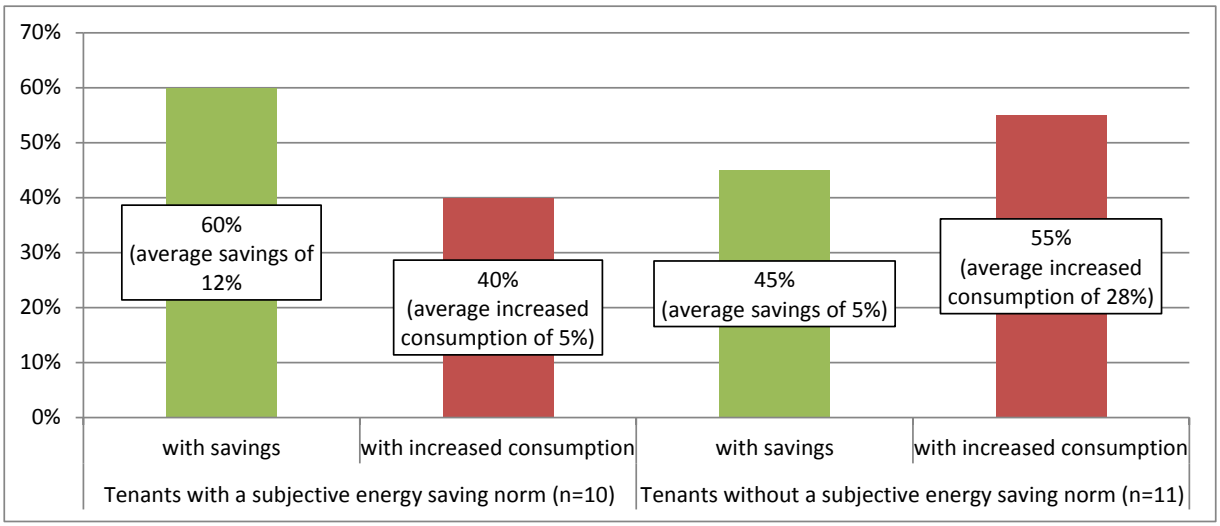
For a better classification of interest was that users reported on more often and longer being at home than non-users. It can be assumed that the differences in presence at home are the main reasons for the above shown differences in average heat energy consumption because the room temperatures are usually higher when being at home than when being absent (see below).

Figure 4-132: Presence at home of users and non-users



Nearly all EAS users (96 %) are (rather) interested in energy issues and energy saving. 72 % would say that they are not well enough informed about heating and warm water consumption. Compared to that non-users more seldom are interested in energy and energy saving (83 %). 42 % of non-users (compared to 28 % of users) feel absolutely well informed about energy saving issues. 56 % of users (rather) think that they should save more energy at home (non-users 72 %).

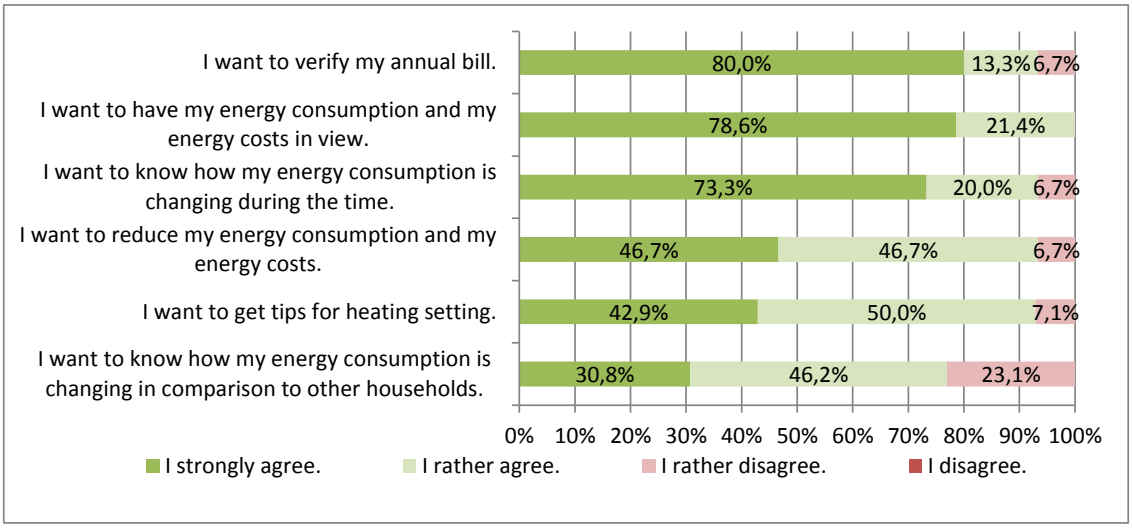
Figure 4-133: Pre-post comparison of energy consumption of tenants with and without subjective energy saving norms



Those tenants who think that they should save more energy at home (tenants with subjective energy saving norm) had better saving results than the remaining tenants who do not think so: 60 % with the subjective energy saving norm had savings of 12 % on average. 40 % had an average increased consumption of 5 %. Tenants without an energy saving norm had to a lower percentage savings (45%) with lower results (average savings 5 %) and a higher percentage of increased consumption (55%) with higher increased consumption values (28% on average).

The majority of users wants to verify the annual bill, wants to have an overview about the energy consumptions and costs and wants to carry out historical comparisons with their heat energy consumption of the previous years.

Figure 4-134: Reasons for EAS use (users only, n=15)



Thinking of the tenant portal,

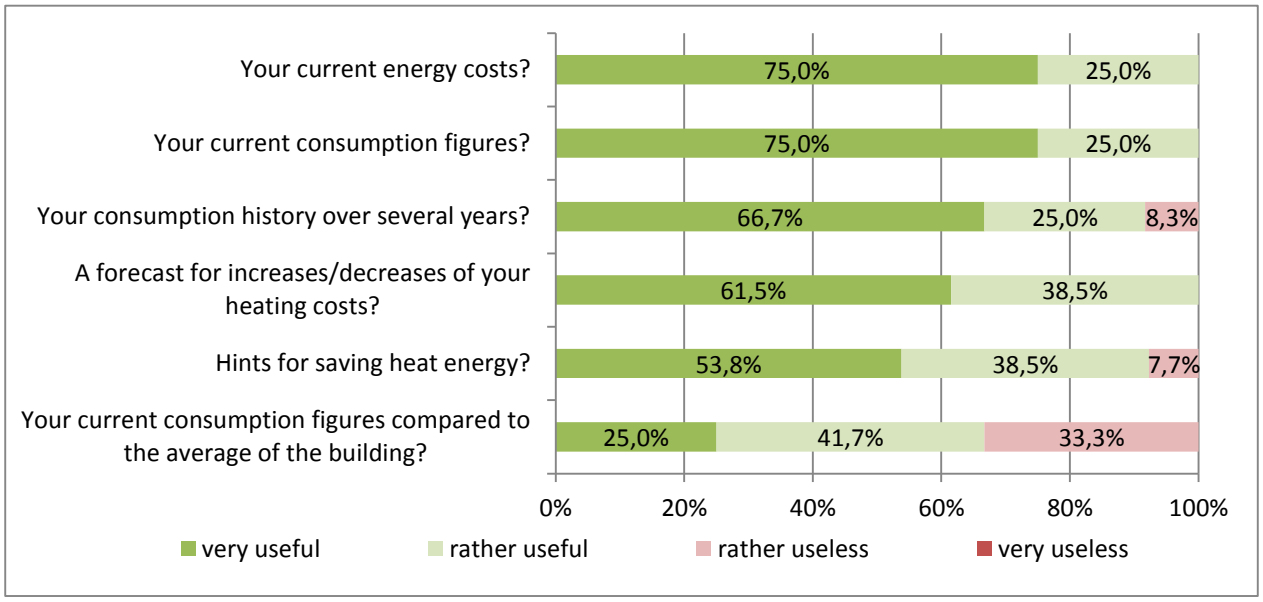
- 83 % of the users have the opinion that they know now more about heat energy consumption

- 85 % lay more emphasis on energy issues by keeping an eye on their energy consumption.

Satisfaction with EAS

All user tenants have the opinion that the current energy costs and consumption figures as well as a forecast for the development of costs for heating provided in the EAS are very resp. rather useful. For the majority of respondents the given tips for energy saving and historical comparisons of consumption figures are also of use. The comparison with the building average is of less importance.

Figure 4-135: Assessment of the usefulness of several EAS information in Solingen (n=12)



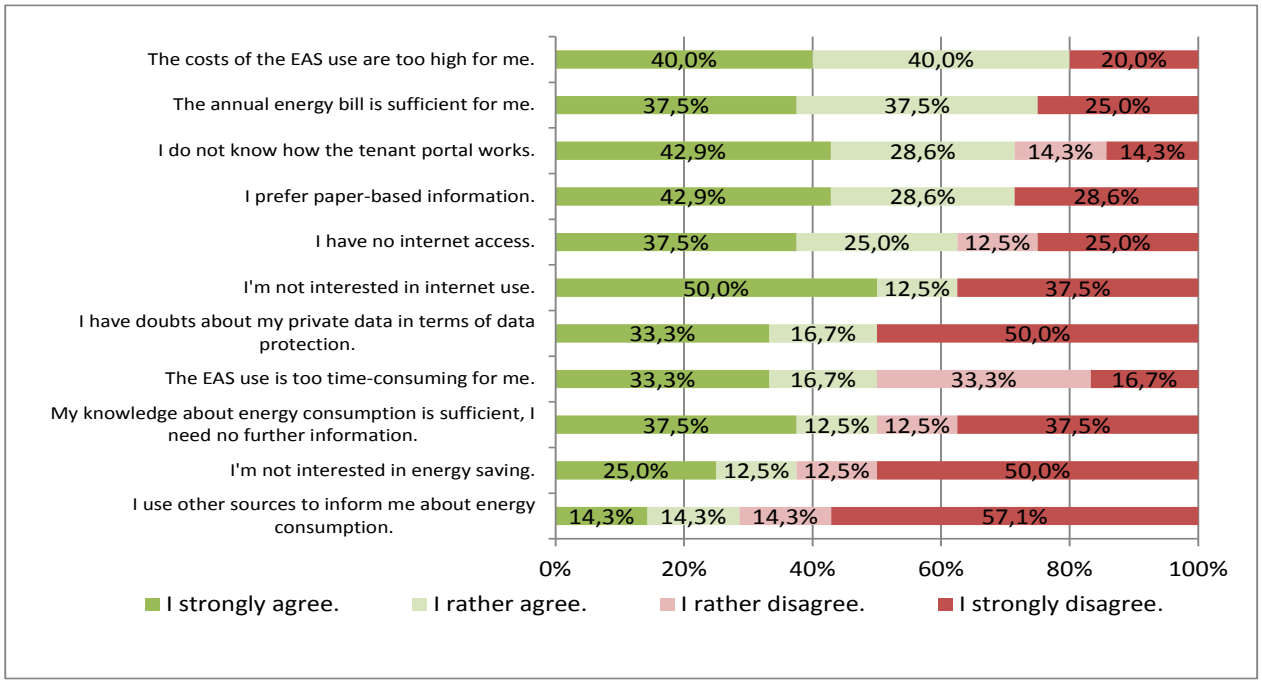
Reasons for EAS non-usage

Part of the tenant questionnaires was also the question for non-users why they are not interested in EAS use. The main reasons for non-usage are

- that the EAS costs are too high (But tenants are under misapprehension because the provided tenant portal is for free usage.)
- that the tenants are not interested in consumption data of periods less than a year because they have the opinion that the annual bill is sufficient for them.
- that they prefer paper-based information, have no internet access, etc.
- that they do not know how the portal works.

Especially the last-mentioned problem could be solved with a better training of tenants. Regarding internet access is to be added that more than half of all non-users (55%) have no possibility to use the world-wide web.

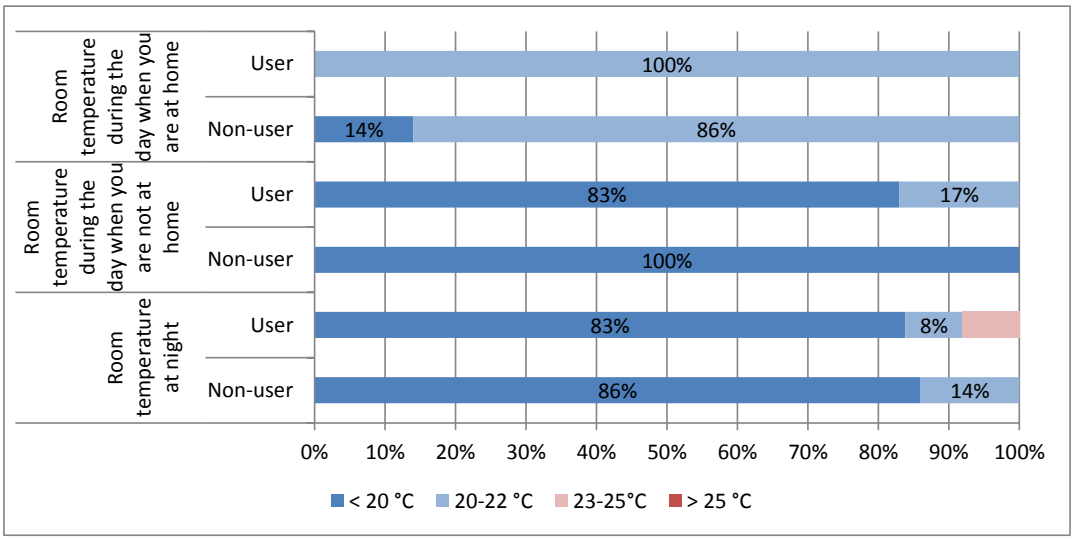
Figure 4-136: Reasons for non-usage of EAS (non-users only, n=12)



Heating and ventilation behaviour of users and non-users

The choice of room temperature and the ventilation behaviour are generally important parameters of heat energy consumption. As the following figures show, most of the respondents – EAS users as well as non-users – already act very energy conscious. The room temperatures are at low levels – in case of absence and at night usually beneath 20 °C. In case of presence at home during the day the room temperatures are not higher than 22 °C. The comparison of users and non-users shows slightly more energy efficient behaviour of non-users. However, the small sample should be considered when interpret the results.

Figure 4-137: Room temperature choice at presence and absence at home by day and at night by users (n=14) and non-users (n=7)



Regarding further heating behaviour EAS users often report mainly on more energy efficient behaviour than non-users.

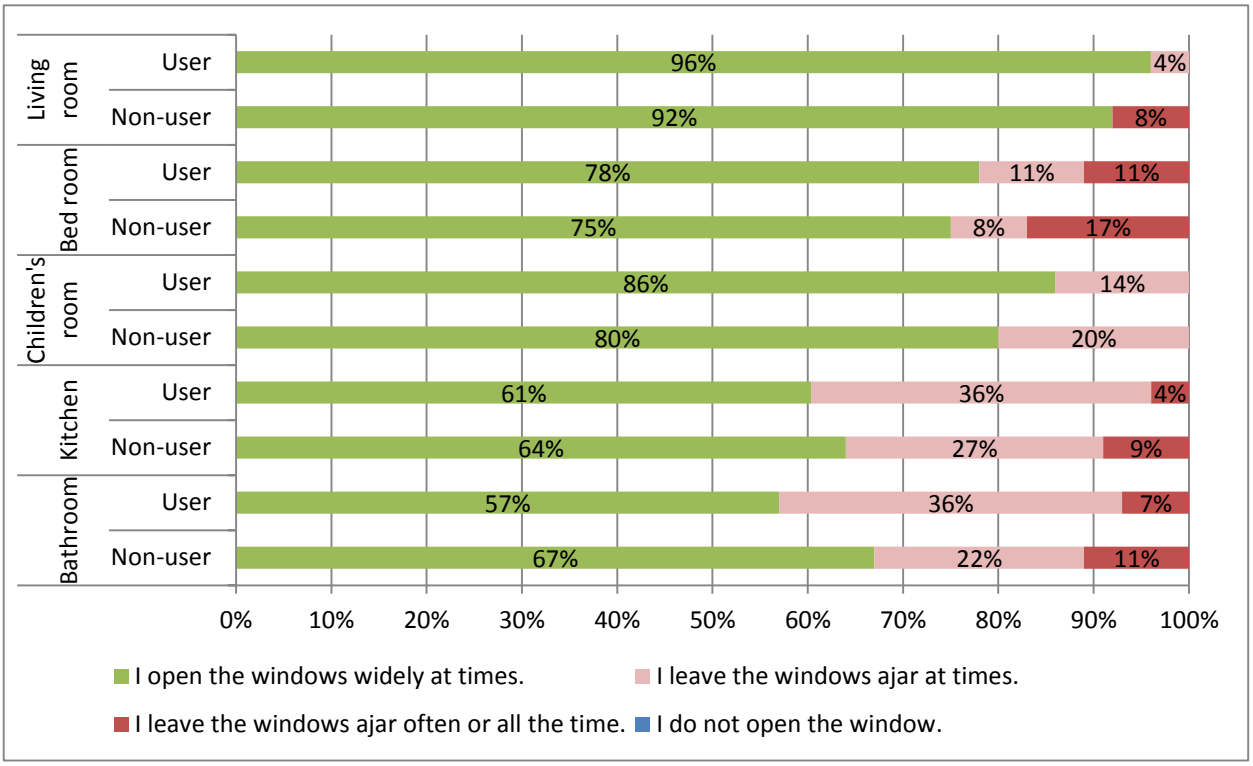
Table 4-64: Heating behaviour patterns ("yes"-answers only)

Aspects	Users (n=27)	Non-users (n=12)
Do you turn off your heating when you open the windows?	74%	36%
Do you turn the heating down when you leave your home for a longer time?	89%	90%
Do you turn the heat down when you leave a room unused?	88%	82%
Do you set the heating on the highest possible level when you are coming home?	11%	17%
Is your heating equipped with an automatic night setback?	56%	42%
If no night setback: Is your temperature at night usually lower than by day.	87%	78%

In addition to that EAS users slightly more often reported on optimal ventilation behaviour in winter or on colder days.

In a further question related to the impact of the EAS nearly two thirds of the users (64 %) reported that they optimised their heating and ventilation behaviour after using the tenant portal. In addition to that, 58 % of users intend to intensify their effort and want to heat more economical in the next winter.

Figure 4-138: Ventilation behaviour in winter of users (n=28) and non-users (n=12)



4.9 North Italy

4.9.1 Background information

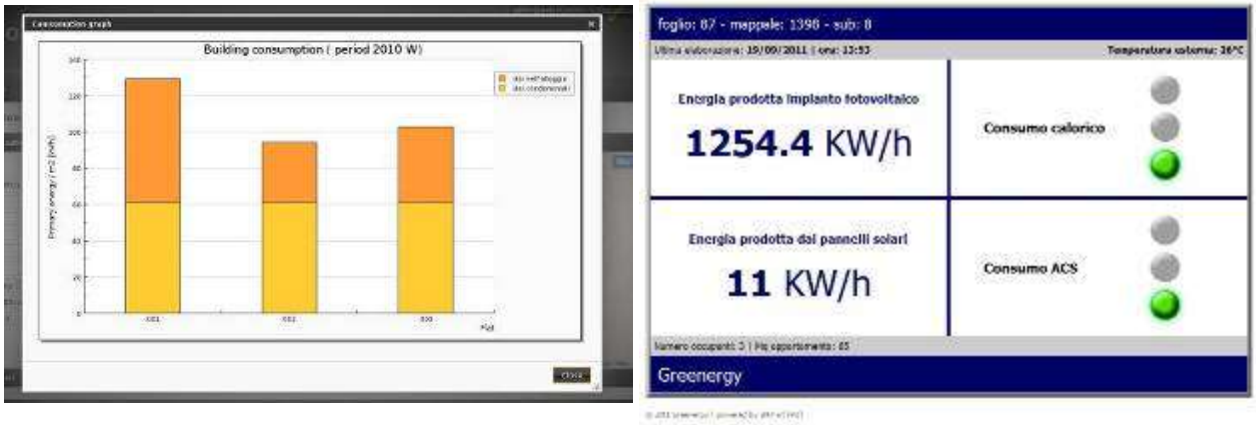
The eSESH service in North Italy contains an EAS system (named SOLE) as well as an EMS service.

As overall EAS service a web application for feedback on energy and water consumption has been implemented. For each pilot flat and pilot building it is possible to know the seasonal consumption of energy (electricity, gas, district heating and other) and water. The application is 100% web based and does not require the installation of new software. The access is available through the website www.sole-project.com. For those tenants who have no internet access available it is possible to receive the relevant data per postal letter.

The 3 buildings in Piacenza have been equipped with room temperature controllers in order to give to the user the possibility to “take action” and program the space heating in an energy efficient way.

The 3 buildings in Fano have been equipped with a monitoring system which allows the user to monitor his real time consumption figures of hot water and space heating, along with room temperature, via a micro-PC which is connected to the TV screen of the user and to a display.

Figure 4-139: Examples of the EAS web portal (left) and the EAS TV solution (right)



The EMS is a separate section of the web portal. It allows the monitoring of centralised renewable energy systems which are installed in the buildings. Through the use of the portal it is possible to assess and compare the performance of a specified system over winter/ summer and/or it is also possible to check the performance of several systems and then compare the outcomes. The service also provides the Housing Company user with the possibility to identify those systems, which are not running at 100% potential and take the necessary actions to improve the situation/ solve the problem.

The pilot site North Italy includes three sub-sites with in total 23 buildings including 468 pilot dwellings.

Table 4-65: Overview of the number of buildings and dwellings involved in the North Italy pilot

Site	Pilot site name	Number of buildings involved	Number of dwellings involved
North Italy	Brescia	17	328
	Piacenza	3	92
	Fano	3	48

The eSESH service is embedded in an energy awareness campaign which includes tenant meetings including training sessions which took place at all sub-sites between December 2011 and February 2012. From March 2012 onwards a letter is sent by mail with the description of the services signed by the presidents of the 3 cooperatives partners of eSESH. The letters have the aim to inform and involve those tenants who have not participated to the meetings. In addition to that, the energy advisor of each Cooperative is always available to provide support to new EAS users. North Italy pilot site also produced a short video[18] presenting the energy consumption web portal, objectives and benefits for the users.

Staff members were trained in October 2011.

The usage of the EAS web portal is measured via counted log-ins which allows for the purpose of evaluation a comparison of users and non-users. 81 tenants make more or less regularly use of the EAS web portal. That equates to 17% of the total number of pilot dwellings. Further 70 tenants subscribed to a postal version of data and information provided by the web portal.

4.9.2 Results of consumption data analysis

In total, 468 dwellings have been equipped with instrumentation. In North Italy, various parameters were measured related to different pilot buildings:

- Electricity in kWh
  - Shared parts of the building and shared parts with mechanical ventilation
  - domestic electricity per flat without cooking, domestic electricity per flat with cooking, domestic electricity with cooking and mechanical ventilation
  - percentage of peak hours
- Natural gas in Nm3
  - hot water heating only
  - space heating only
  - cooking only
  - hot water heating, space heating and cooking
- District Heating in kWh

[18] www.youtube.com/watch?v=a8oeMQE6Zb8

- warm water only
- space heating only
- space heating and warm water combined

- Water in m3
  - hot and cold water combined
  - hot water separately
  - cold water separately

Before analysing the data, it was necessary to cleanse it in order to take into account the change of tenancy as well as some incoherencies or periods of absence of the tenants. In those cases, the dwellings were excluded from the analysis. The dataset analysed represents nearly 65% of the whole dataset.

Table 4-66: Description of the cleansing step

Cleansing		
Data	Number of dwellings	
	Before cleansing	After cleansing
Electricity	435	253
Gas natural	687	480
District heating	188	95
Water	468	340

For calculating the savings a pre-post comparison is used. The eSESH service started operation in November 2011. The pre-post comparison is based on the analysis of the evolution of the consumption figures before and after the implementation of the service. As in North Italy the measures are bi-annual, one in winter (16th of October - 15th of April) and one in summer (16th of April - 15th of October), the baseline period is 16/10/2009 – 16/10/2011and the reporting period is 16/10/2011– 16/04/2012.

Global results of consumption data analysis (EAS)

The global calculation of savings following a pre-post-comparison led to the results shown in the following table.

Compared to the expected savings in total of 10% the savings of nearly 7% for natural gas and nearly 6% for water are very promising.

Considering primary energy, the savings made concerning electricity, district heating and natural gas lead to a global percentage of savings in primary energy of 5.7%.

Table 4-67: Overview of global results in North Italy (EAS)

Key data				
	Electricity	Gas natural	District heating	Water
Number of dwellings	253	-	-	340
Surface area (average)	72	71	75	72
Number of people (average)	-	-	-	-
Global Results for the dataset of dwellings				
	Electricity	Gas natural	District heating	Water
Savings (%) - eeMeasure (weighted)	4,50%	6,60%	4,15%	5,60%
Saving (kWh/yr or m3/yr) - eeMeasure	23 400	155 078	17 586	2 504
Carbon Dioxid Reduction in kgCO2/yr - eeMeasure	16 567	36 777	2 726	-
Financial Saving (€/yr) - eeMeasure	4 118	12 453	2 075	-
Consumption Before Intervention (kWh/yr)	527 461	2 356 614	404 049	44 716
Results (per dwelling, per people or per m²)				
	Electricity	Gas natural	District heating	Water
Consumption Unit	*(kWh/m².year)*	*(kWh/m².year)*	*(kWh/m².year)*	*(m3/m².year)*
Consumption - Before intervention	-	-	-	1,8
Consumption - After intervention	-	-	-	1,7
Consumption Unit	*(kWh/dwelling.year)*	*(kWh/dwelling.year)*	*(kWh/dwelling.year)*	*(m3/dwelling.year)*
Consumption - Before intervention	-	-	-	132
Consumption - In the same country*	-	-	-	-
Saving (kWh/dwelling.yr or m3/dwelling.yr) - eeMeasure	-	-	-	7
Carbon Dioxid Reduction in kgCO2/dwelling.yr - eeMeasure	-	-	-	-
Financial Saving (€/dwelling.yr) - eeMeasure	-	-	-	-
** See references*				

Electricity

Two types of dwellings were included in the section dedicated to electricity. In parts of the dwellings electricity is used for electrical appliances and lighting only, in others cooking is also included.

The two following figures show the levels of annual consumption related to the size of the dwelling. It can be observed that the level of consumption does not depend on the size of the dwelling.

Besides, the comparison between these both graphs shows that the highest consumers (circled in the first chart) have been especially impacted by the service.

It can also be assessed a global decrease of the consumption as highlighted on the second graph.

Figure 4-140: Annual Electricity Consumption (in kWh/m²) related to the surface of the dwelling in m², in 2009/2010

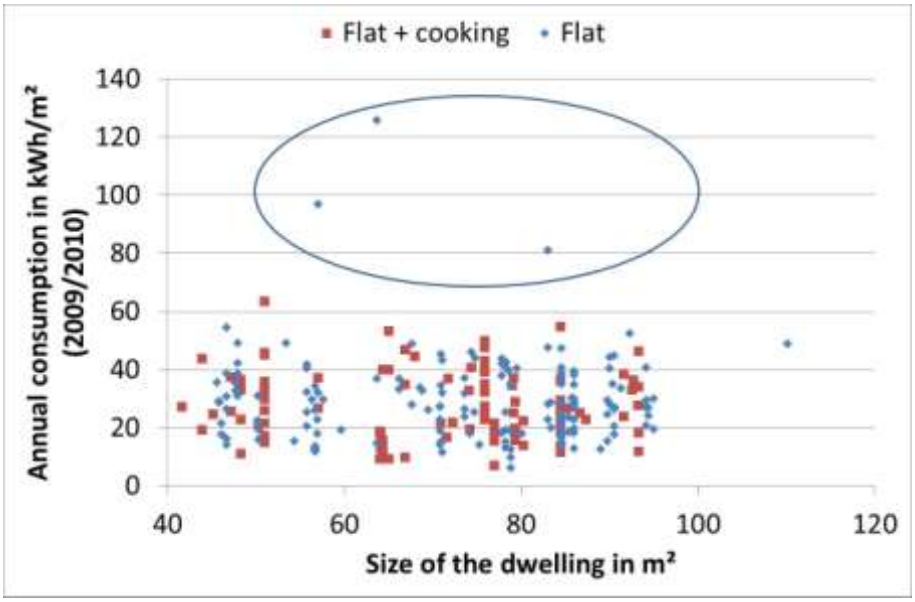
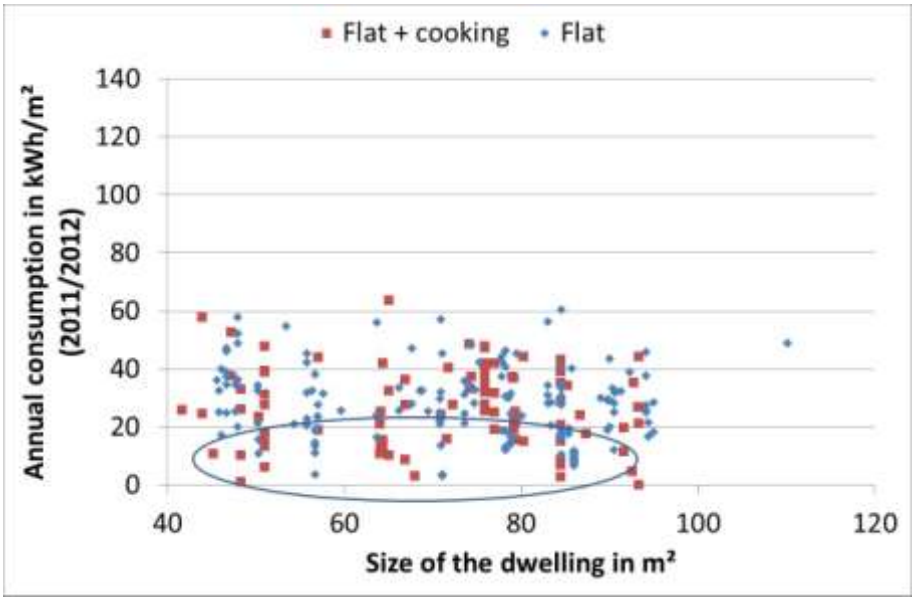


Figure 4-141: Annual Electricity Consumption (in kWh/m²) related to the surface of the dwelling in m², in 2011/2012

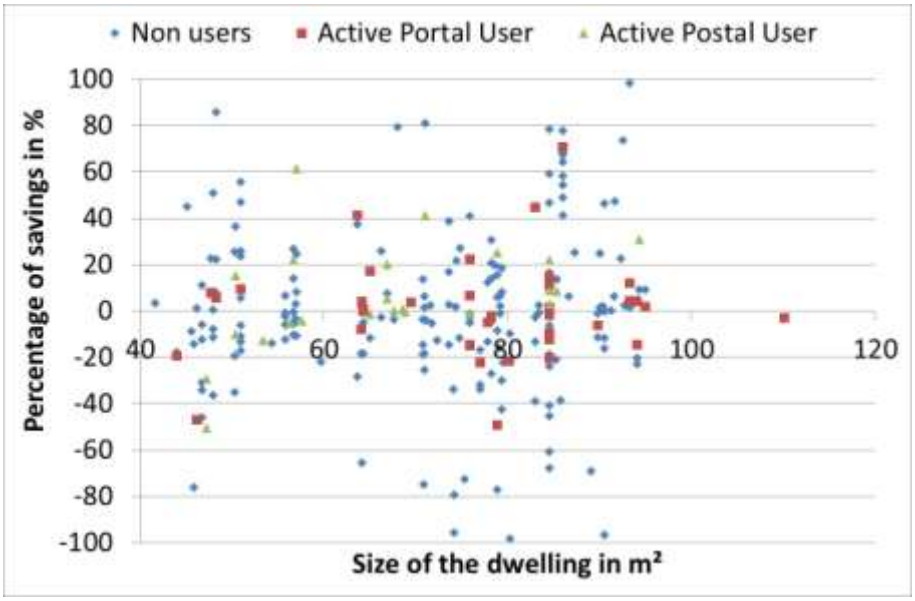


It was further interesting to study the relation between the percentage of savings and the size of the dwelling.

In the following chart three types of tenants are represented. This differentiation will be described later on. What can be concluded from this graph is that many tenants achieved savings. Indeed, 50% of the dwellings made savings.

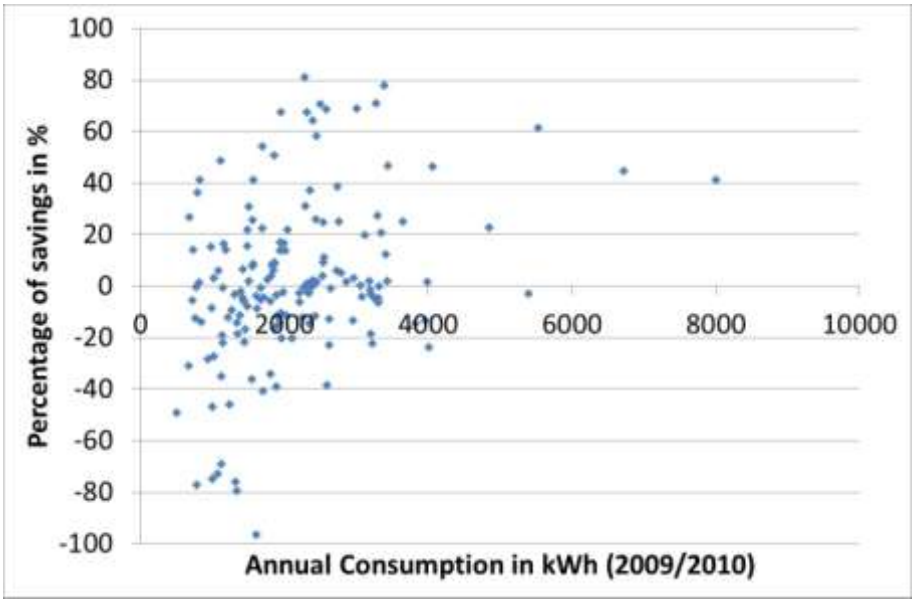
Moreover, considering the whole sample, no correlation can be detected concerning a tendency of tenants in large-sized dwellings to have a divergent behaviour in terms of savings.

Figure 4-142: Percentage of savings (+ values) related to the surface of the dwelling in m²



In the following the surface of the dwelling has been replaced by the annual electricity consumption of the baseline period. This chart shows again that especially the highest consumers achieved significant savings.

Figure 4-143: Percentage of savings (+ values) related to annual electricity consumption in kWh, for the dwellings in which electricity is used for the flat and the cooking



Natural Gas

Four types of measurements have been included in the section dedicated to natural gas. In some of the dwellings the measurement of the natural gas consumed corresponds to:

- Water heating
- Space heating
- Cooking
- All three usages together

In fact, in parts of the dwellings the three usages are measured separately, in others the three usages are combined. Due to the cleansing step it was not possible to have a global dataset combining the three usages (indeed, in some cases the consumption of natural gas for water was available but not for space for example).

Figure 4-144: Annual natural gas consumption (in m3/m²) related to the surface of the dwelling in m², in 2009/2010

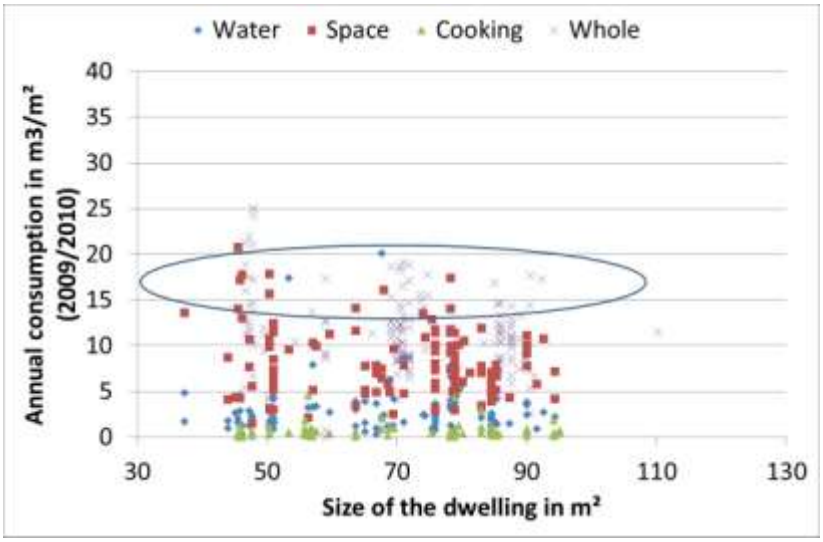
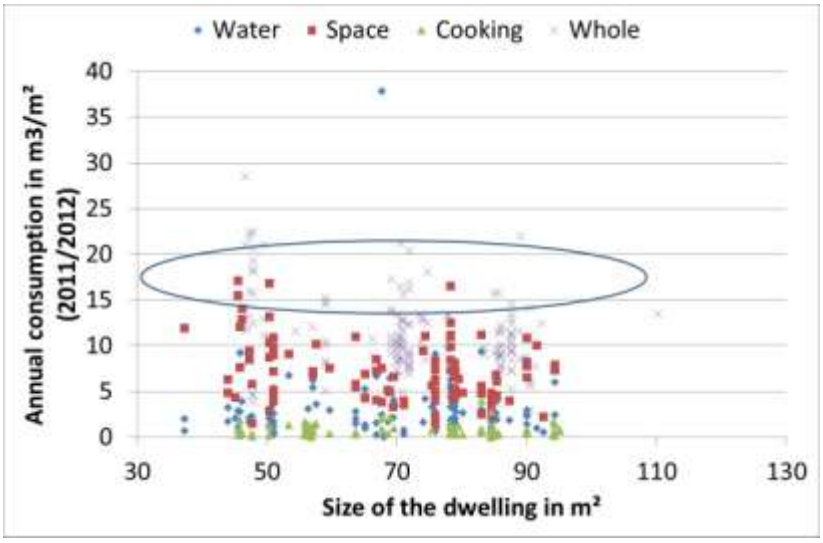


Figure 4-145: Annual natural gas consumption (in m3/m²) related to the surface of the dwelling in m², in 2011/2012



The two above charts show the levels of annual consumption related to the size of the dwelling. It can be observed that the level of consumption does not depend on the size of the dwelling - except for space heating for which a tendency of the tenants in small dwellings becomes obvious to consume comparably more (in m3/m²) than in large-sized dwellings. Besides, the comparison between both graphs shows that the highest consumers (circled) have been especially impacted by the service. It can also be assessed a global decrease of the gas consumption (as highlighted on the second graph).

It was further of interest to study the relation between the percentage of savings and the size of the dwelling.

In the next figures is shown that a large majority of the dwellings achieved savings (60%). This especially applies to space heating and cooking. Indeed, the second graph shows that in the case of water a higher dispersion concerning the percentage of savings is obvious.

Figure 4-146: Percentage of savings (+ values) related to the surface of the dwelling in m², for the different usages

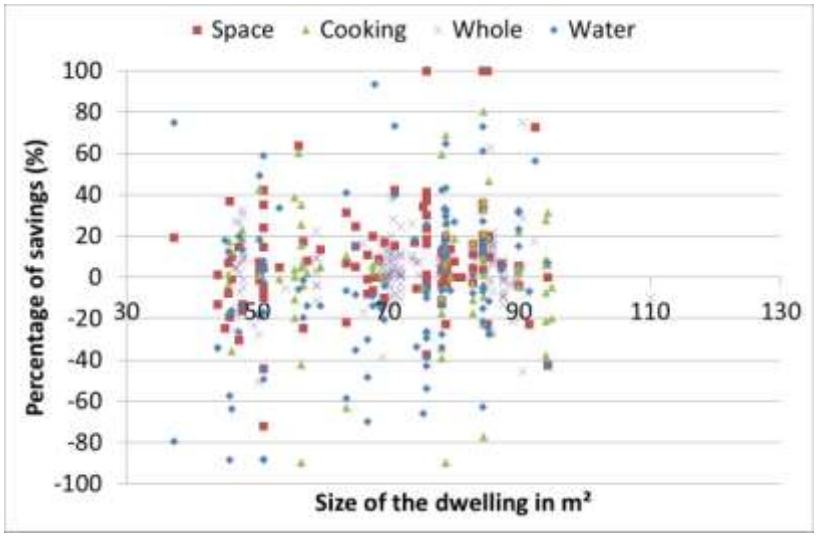
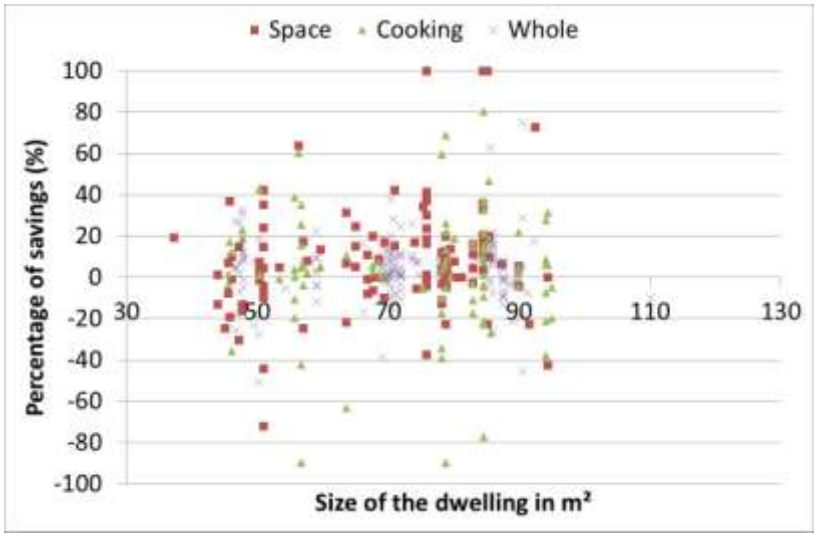
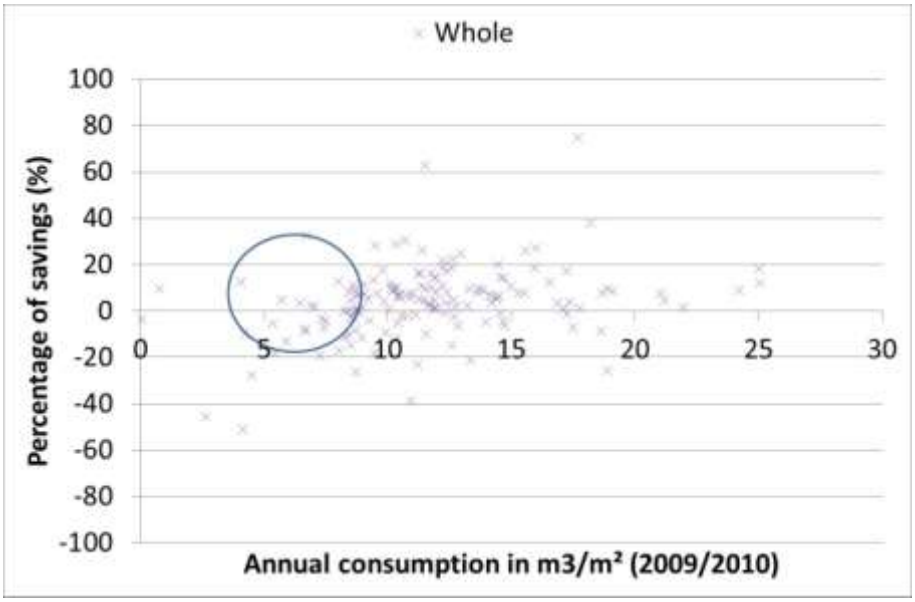


Figure 4-147: Percentage of savings (+ values) related to the surface of the dwelling in m², for the different usages, without Natural Gas for water heating



In the following figure the surface of the dwelling has been replaced by the annual natural gas consumption of the baseline period. This chart shows that there is no real correlation between the level of consumption and the percentage of savings. Nevertheless, it can be pointed out that the low consumers seem to achieve less gas savings than the high consumers.

Figure 4-148: Percentage of savings (+ values) related to annual natural gas consumption in kWh, for the dwellings in which the measurement of the whole usages is combined



District Heating

Three types of measurements are included in the section dedicated to district heating. The measurement of district heating consumption corresponds to the following usages:

- Water heating
- Space heating
- The two usages combined

As for natural gas, in parts of dwellings both usages have been measured separately and in others both usages are combined. Due to the cleansing step, it was not possible to have a global dataset combining the two usages.

The two following charts show again the levels of annual consumption related to the size of the dwelling. It can be observed that the level of consumption does not depend on the size of the dwelling. It can also be assessed a slight decrease of district heating consumption.

Figure 4-149: Annual Consumption (in kWh/m²) related to the surface of the dwelling in m², in 2009/2010

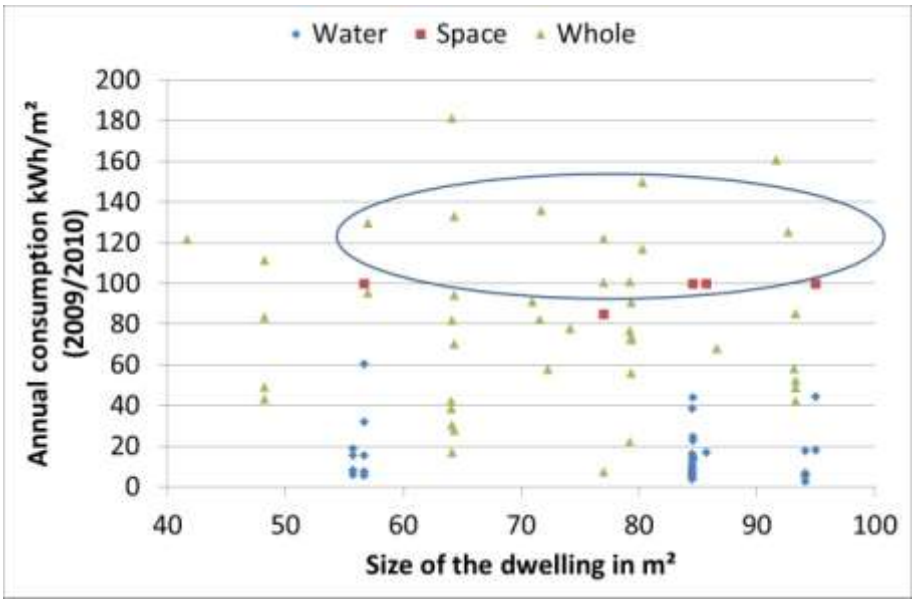
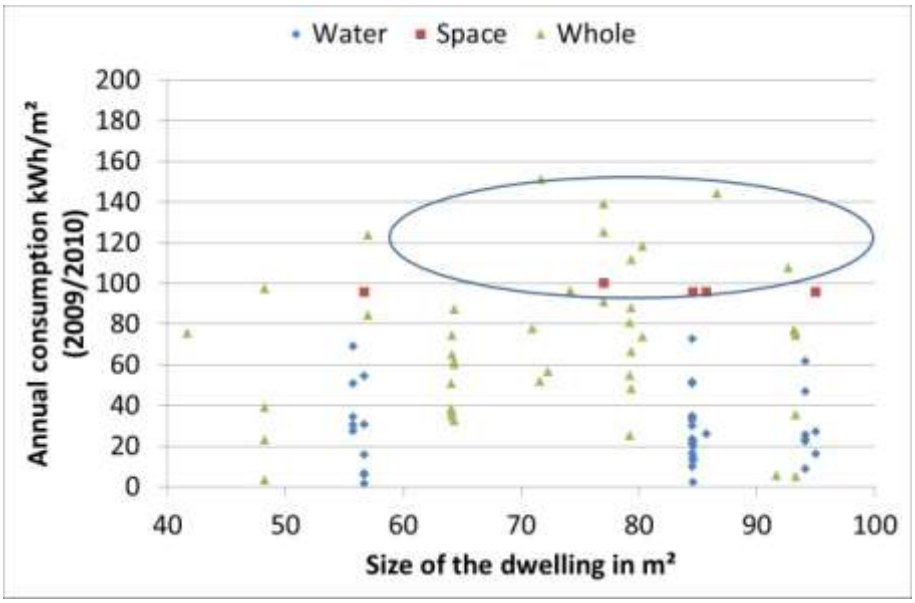
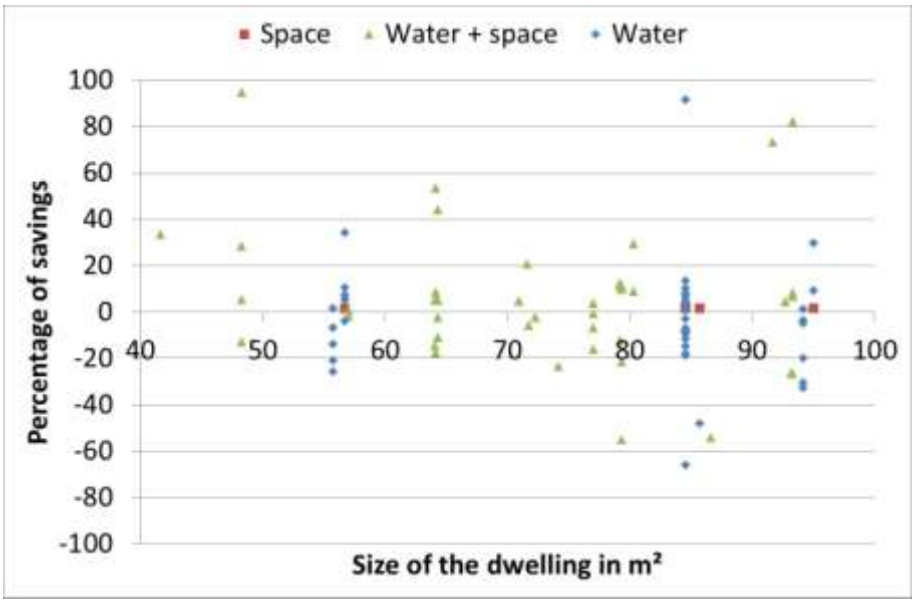


Figure 4-150: Annual Consumption (in kWh/m²) related to the surface of the dwelling in m², in 2011/2012



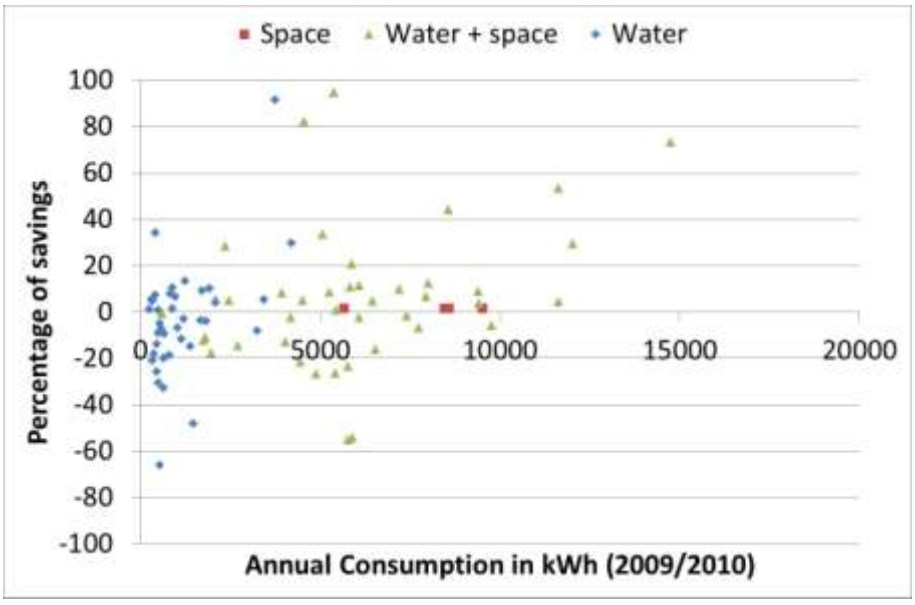
The study of the relation between the percentage of savings and the size of the dwelling showed no correlation. But, thanks to the following chart, it can be observed that a majority of tenants achieved savings (58%).

Figure 4-151: Percentage of savings (+ values) related to the surface of the dwelling in m², for the different usages



That result is also obvious in the following figure where the surface of the dwelling has been replaced by the annual consumption of the baseline period.

Figure 4-152: Percentage of savings (+ values) related to annual consumption in kWh



Water

In the case of water, the global savings reached 5.6%. Moreover, 55% of the dwellings made savings which is a promising result.

Comparison between users and non-users

In the North Italian pilot site all tenants received a paper consumption report to introduce the project. In addition to that, parts of these tenants became active users of the EAS web portal and received a personal account. Thus, in the following active users of the EAS portal have been considered as users. Non-users are those tenants who didn't become portal users.

A pre-post comparison for users and non-users was possible for the different measured data as described above. As the following table shows, in the case of electricity the users achieved more savings than the non-users. Even if the difference between users and non-users doesn't seem very conclusive, an important observation is that more than half of the tenants made savings which is a promising result.

Table 4-68: Distribution by users and non-users in the cleansed consumption dataset with savings calculation

Comparison between users and non-users									
		Electricity		Gas natural		District heating		Water	
Total of dwellings	Users	59	23%	164	34%	25	26%	112	33%
	Non Users	194	77%	316	66%	70	74%	228	67%
	Total	253	100%	480	100%	95	100%	340	100%
Surface per dwelling	Users	72,74		70,43		80,41		72,54	
	Non Users	71,65		71,68		73,54		72,24	
People per dwelling	Users	-		-		-		-	
	Non Users	-		-		-		-	
Average Annual Consumption 2011 (baseline period)	*Unit*	*kWh/(dw.year) in 2011*		*kWh/(dw.year) in 2011*		*kWh/(dw.year) in 2011*		*kWh/(dw.year) in 2011*	
	Users	-		-		-		113	
	Non Users	-		-		-		125	
%of dwellings which made savings	Users	54%		56%		56%		54%	
	Non Users	49%		62%		58%		55%	
	Total	50%		60%		58%		55%	
Savings (%)	Users	7,00%		4,46%		3,00%		1,40%	
	Non Users	3,00%		7,76%		4,00%		7,60%	

Global results of consumption data analysis (EMS)

As described in the introduction, the EMS is a separate section of the web portal. It allows the monitoring of the centralised renewable energy systems which are installed in the pilot buildings. Thanks to this section of the web portal, the Cooperative is able to detect and define problems and malfunctions which can occur on the systems and as a consequence to solve them. Thus, the aim is first to have a stable and decent productivity, and then, once this stability is ensured, the aim of this system will be to tune and optimize the productivity.

In North Italy the buildings have been equipped with Solar Thermal Systems and/or Solar Photovoltaic Systems. These systems started operation at different dates from 2004 on.

By comparing the productivity of the Solar Photovoltaic systems with identical plants it is possible for the Housing Company as user to evaluate the optimal tilt angle and orientation and to take the necessary actions to improve the productivity of the systems. Thus, technical interventions can be scheduled to solve problems:

Repositioning of modules,

- Cleaning of the PV modules (the decrease of the productivity can be a consequence of the dirt which tends to accumulate on low tilted modules)
- Electrical malfunctions
- Replacement of a faulty inverter/ module for PV
- Replacement of the thermal fluid providing of a partial shading of the collectors in summer for solar thermal systems

Concerning the Solar Thermal systems, problems occurred such as:

- Impact of low temperatures on the system in Winter
- Evaporation problems when hot water consumption is low

The SOLE service enables to highlight these problems and malfunctions and to solve them more efficiently by scheduling specific technical interventions.

4.9.3 Results of tenant survey analysis

In North Italy two tenant surveys have been carried out – the baseline survey in December 2011 and the final survey at the end of the reporting period in November/ December 2012. Both surveys mainly focussed on user behaviour, user acceptance with the provided EAS and socio-demographic characteristics of the tenant households.

In total, 201 of the total number of 468 pilot tenants (43%) participated at least in one stage of the survey. Thereof 59 tenants (13%) participated in both stages of the tenant survey which allows pre-post-comparisons. That's why the following results will – unless otherwise described – focus on the longitudinal sample.

Among the sample of the longitudinal study are 71% EAS users, most of them (37%) of the online version (see first following figure). The remaining 34% receive their portal data by letter. Compared to the total survey sample the percentage of EAS non-users is significantly lower (29% compared to total 50%).

All eSESH service users of the longitudinal study have an internet access available. In contrast to that 44% of non-users and 63% of the users who receive postal EAS information are not equipped with an internet access at home.

As the second following figure shows are users of the tenant internet portal comparably younger, better educated and live more often in bigger households (families of three or four) than users of the postal information or non-users. The income has not been inquired but it is very likely that these bigger and well-educated families have a greater interest in saving running costs as well as a higher internet affinity than the others. The most respondents of especially the group of EAS letter users (70%) as well as non-users (47%) are at least 55 years old. That corresponds to several statistics which describe a lower internet affinity of the elderly. Only two persons in the longitudinal study, both non-users, were not born in Italy.

Figure 4-153: Number of users and non-users of EAS in the tenant survey sample of North Italy

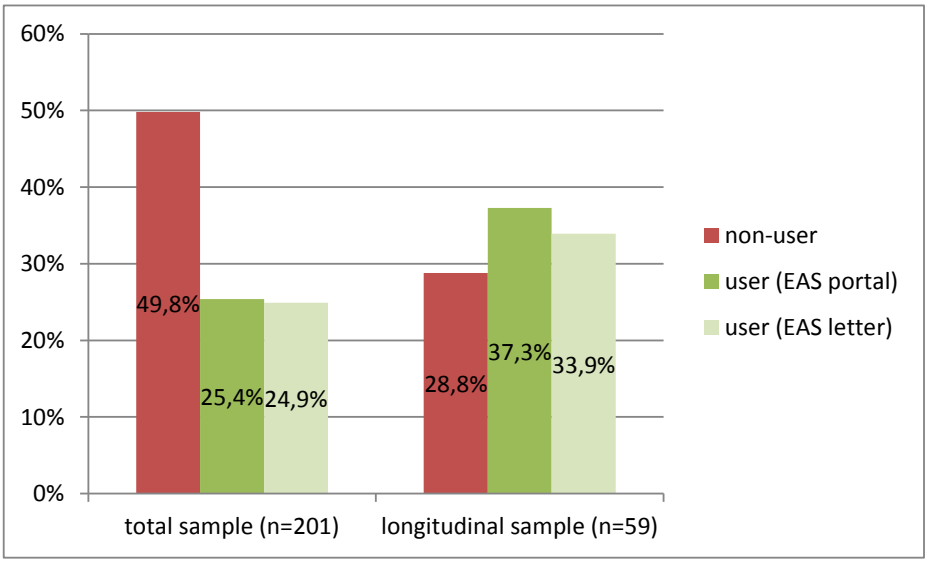
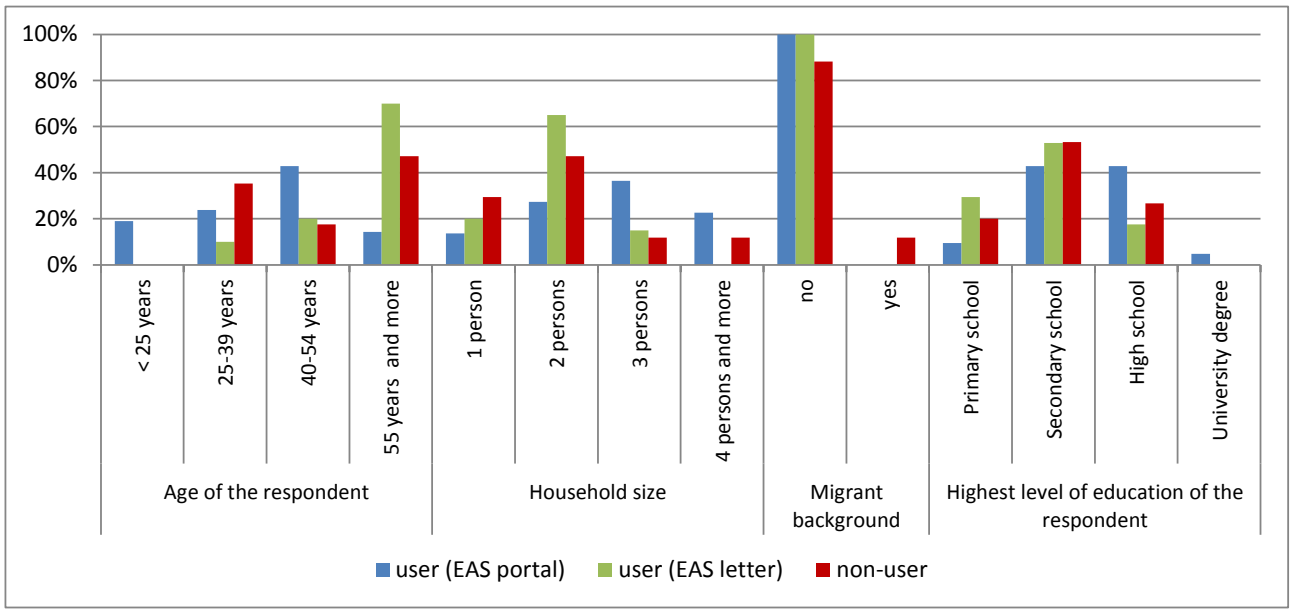


Figure 4-154: Age, household size and migrant background of the questioned EAS users and non-users (related to responses of the final survey, n=59)



Changes in energy consumption behaviour after EAS use

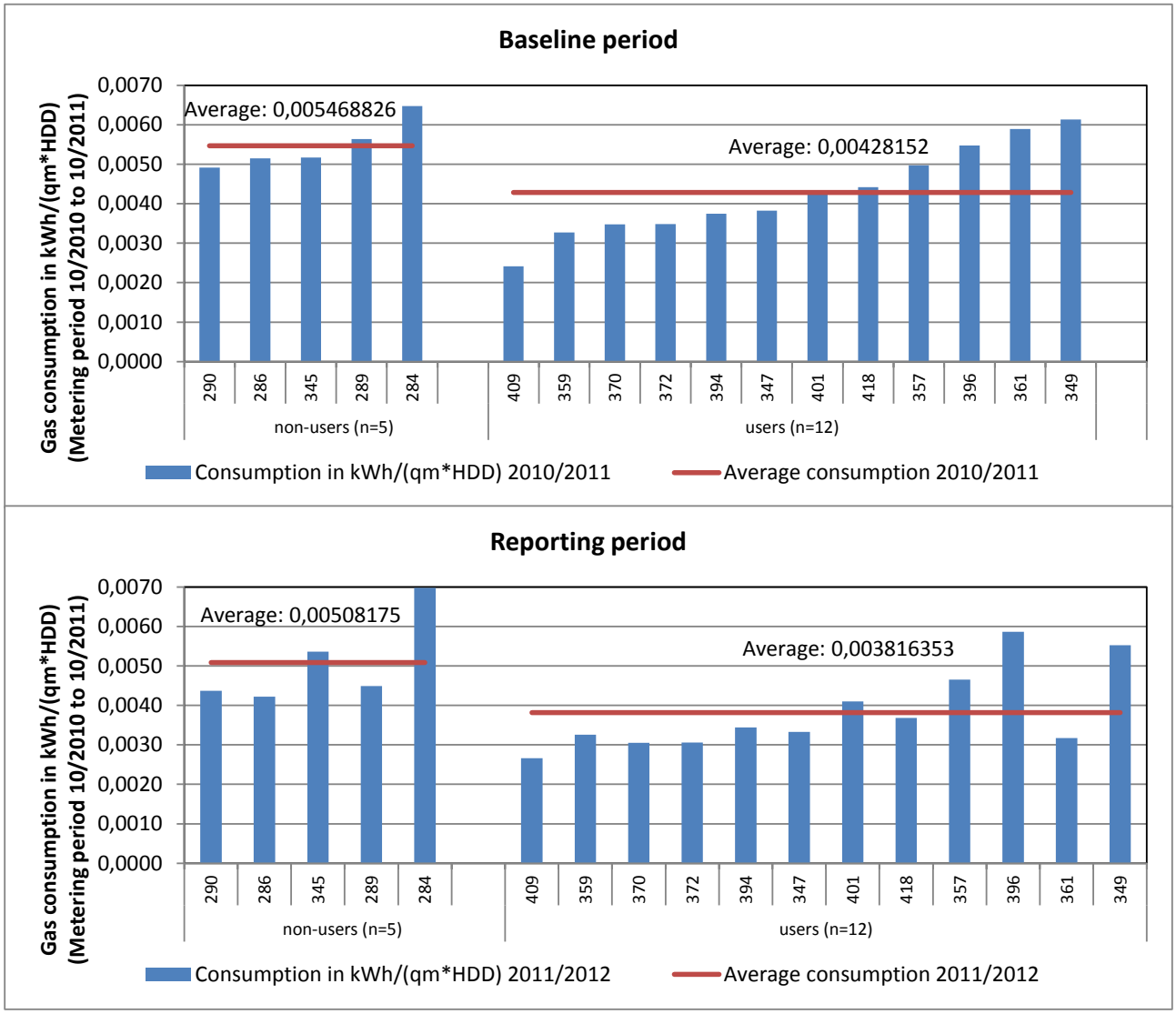
In addition to the above described consumption data analysis it was possible to carry out a combined analysis of before and after reported energy consumption behaviour and measured consumption data with a subgroup of the longitudinal sample. Both tenant questionnaires included equal questions regarding typical heating and hot water consumption behaviour patterns which could be linked with the corresponding measurements. Seeing the special case of North Italy with the huge variety of different measured energy types only the measurements of gas consumption for the field of application of heating, domestic hot water and cooking could be included. The remaining relevant measurements including heating data (gas consumption for heating only, district heating for heating only and district heating for heating and hot water) were available for too small samples of 2 up to 7 respondents. The following analysis includes a small sample of

17 respondents (12 users (portal + postal) and 5 non-users) which also cannot provide generalised results, but it can show first positive tendencies.

Regarding to the shown mean gas consumption values in **Fehler! Verweisquelle konnte nicht gefunden werden.** first of all can be stated that EAS users have a gas consumption (related to dwelling size) in both comparison periods which is (nearly) one quarter lower than that of non-users (baseline period: 22%, reporting period: 25%). In the pre-post comparison in both groups gas savings were obvious at which the EAS users saved more energy than the non-users:

- EAS users: gas savings of 11%
- EAS non-users: gas savings of 7%

Figure 4-155: Pre-post comparison of gas consumption figures (in kWh/m²*Kd) of EAS users and non-users (used for heating, hot water and cooking, longitudinal sample only)



The reasons for that positive evolution can be found in the following table. EAS users reported now more often on:

- winter room temperatures in the living room lower than 21 °C

- turning down the heating in unused rooms
- turning down the heating when they leaving their home for a longer time
- rather taking a shower instead of a bath
- normally washing their hands with cold water

Further information demand can be deduced from the answers regarding ventilation behaviour where the non-users perform better.

Table 4-69: Pre-post comparison of aspects of heating consumption behaviour by users (n=12) and non-users (n=5)

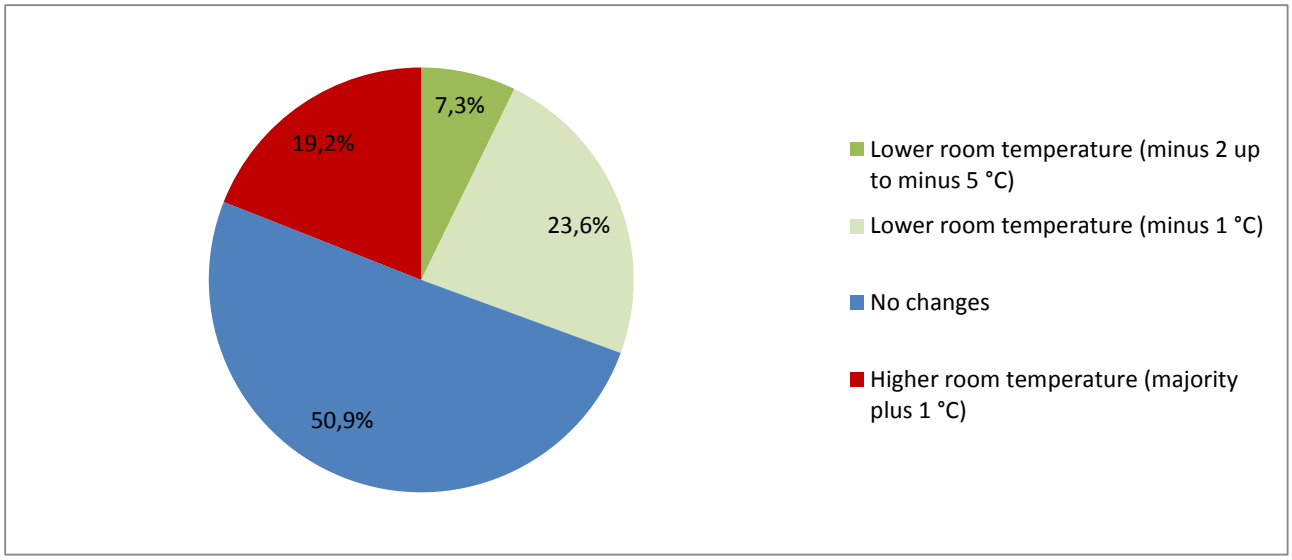
Aspects	value labels	User		Non-user	
		Before	After	Before	After
Do you turn off the heating when you open the window?	yes	83,3%	66,7%	80,0%	80,0%
Do you turn the heating down when you leave a room unused?	yes	45,5%	66,7%	20,0%	60,0%
Do you turn the heating down when you leave your home for a longer time?	yes	63,6%	72,7%	100,0%	100,0%
Do you turn down the heating at night?	yes	90,9%	91,7%	100,0%	80,0%
Do you rather take a shower instead of a bath?	yes	91,7%	100,0%	75,0%	100,0%
Do you use normally cold water to wash your hands?	yes	41,7%	58,3%	100,0%	100,0%
How do you usually ventilate your home in winter time?[19]	I open the windows widely at times.	66,7%	12,5%	75,0%	100,0%
	I leave the windows ajar at times.	33,3%	87,5%	25,0%	
Which room temperature does your living room have in winter?	< 21°C	58,3%	83,3%	100,0%	75,0%
	21-23°C	33,4%	16,7%		
	23-25°C	8,3%			25,0%
	>25°C				

A view on the total longitudinal sample (see xxx) shows that 31 % of the respondents reduced their room temperature in the living room between 1 up to 5 °C compared to the baseline period. All these tenants now have living room temperatures up to 21 °C. Those tenants who reported on

[19] Only respondents without mechanical ventilation system

unchanged room temperatures also have such low temperatures in their living rooms. The same applies to 50 % of the tenants who reported higher room temperatures in the reporting period compared to the baseline period. That means that only 5 of the 55 tenants, who participated in the longitudinal study, remain who have now winter indoor temperatures higher than 21 °C. That is a very positive result - seeing the fact that the individually chosen indoor temperatures have a very big impact on heat energy consumption.

Figure 4-156: Changes in temperature setting in the living room in winter compared to baseline survey (total longitudinal sample)



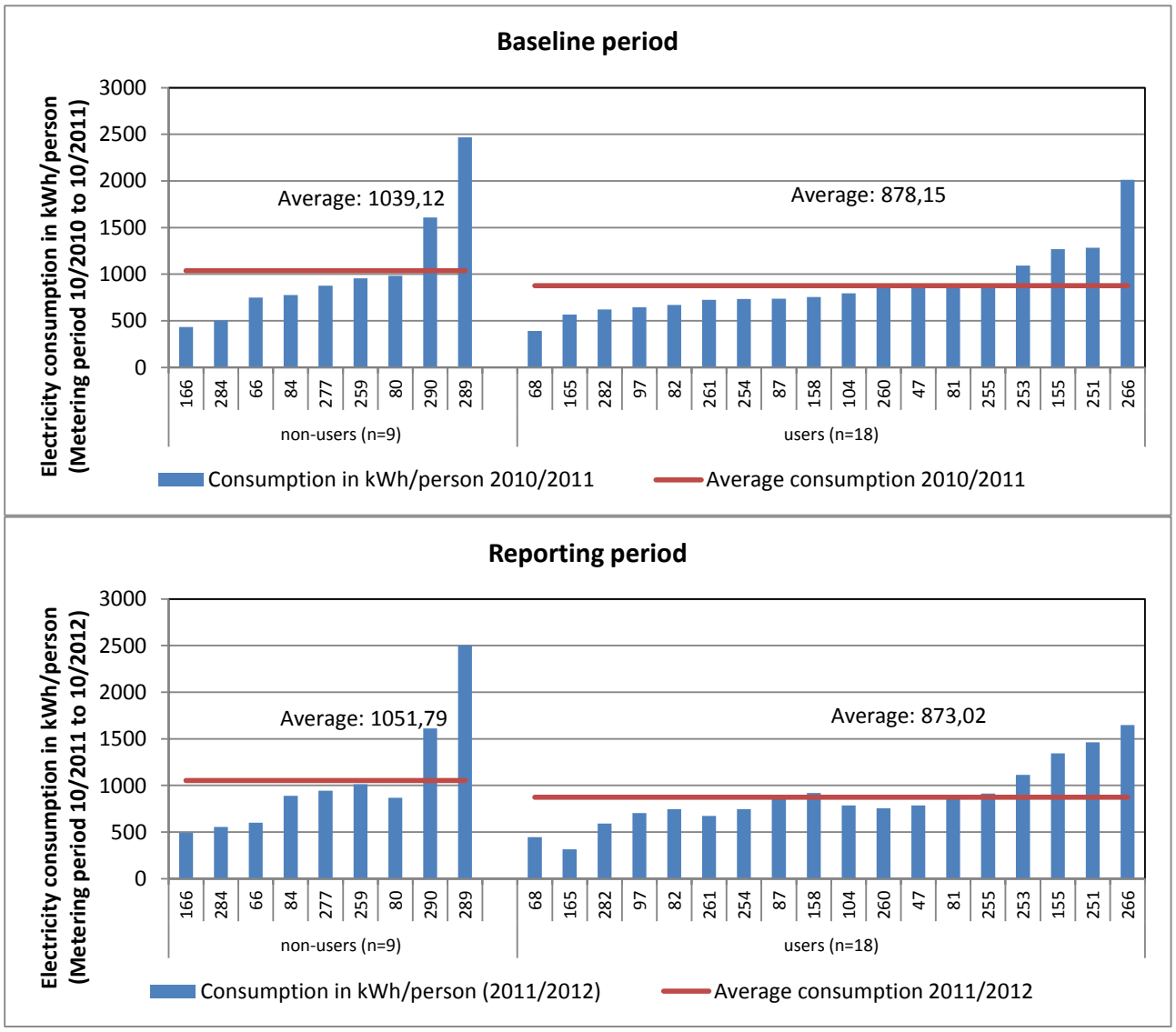
In a similar way the evolution of electricity consumption (domestic electricity without heating and cooking) has been analysed. As the following table again shows is the average electricity consumption of the users lower than that of the non-users. It has also to be stated that the consumption of users is already about a quarter lower than the Italian average value (in 2010: 1,201 kWh per capita; taken from ISTAT-report 2011 (National Institute of Statistics)).

The pre-post comparison shows nearly constant electricity consumption in both comparison periods:

- The users have achieved little savings of 0.6%.
- The non-users have a slight increase of 1.2%.

The tenant households with the highest electricity consumption (users with the number 253, 155, 251, 266; non-user 289) are households with an air condition system which they use regularly on hot summer days. The majority of these tenant households belongs to the age group 55 years and more which may imply a medical necessity of cooler room temperatures in hot summers.

Figure 4-157: Pre-post comparison of electricity consumption figures (kWh/person) of EAS users and non-users (domestic electricity without cooking and heating, longitudinal sample only)



The analysis of the responses regarding electricity consumption behaviour (see Table 4-70) shows that tenants act already widely energy consciously: The majority of respondents switch off their electrical appliances or light when not using it or wait until having a full load before using the washing machine. Anyway the impact of these behaviour patterns on electricity consumption is very limited. Better results could be achieved by replacing of big domestic appliances. In view of the specific clientele of social housing tenants with very low incomes cannot be expected – without specific support e.g. from the municipality – that they will buy newer and more energy efficient equipment until the old ones still working sufficiently. Nevertheless, in case of purchasing a new electrical appliance most of the respondents mind its energy consumption.

Table 4-70: Pre-post comparison regarding the use of electrical appliances by users (n=18) and non-users (n=9)

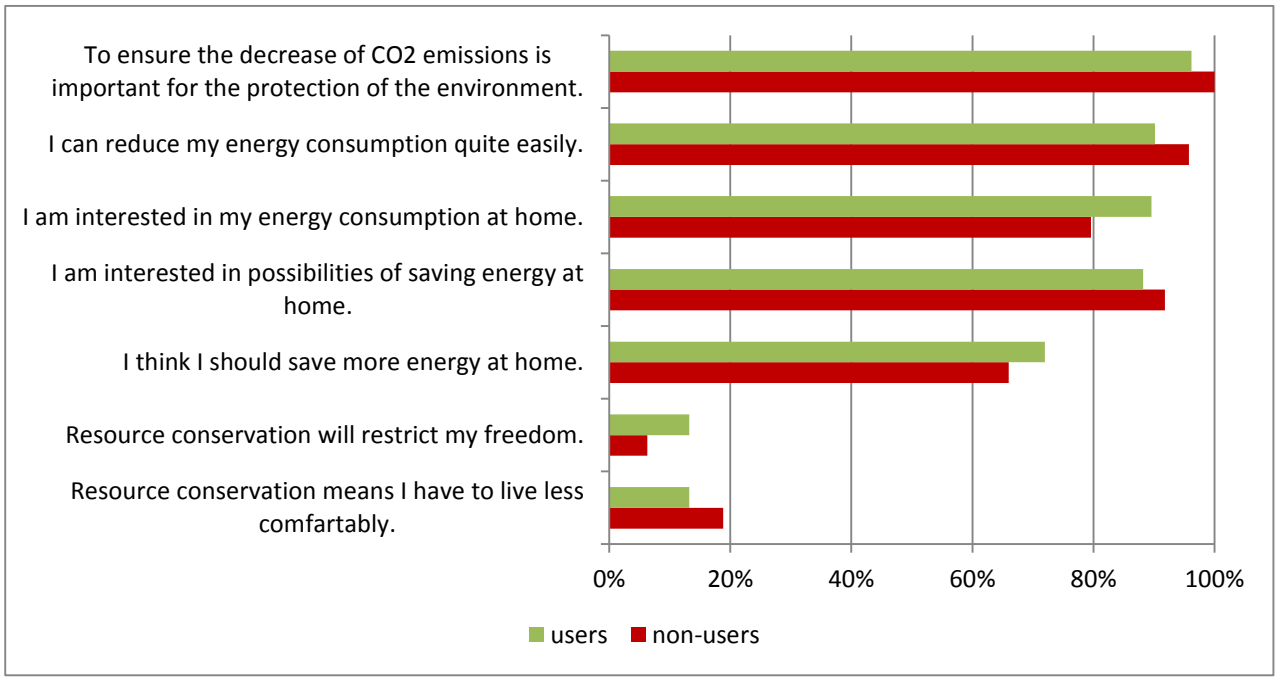
Aspects	value labels	User		Non-user	
		before	after	before	after
Do you switch off the TV or other equipment when unused?	yes	100%	94%	100%	100%
Do you turn off the light when no one is in a room?	yes	100%	94%	100%	100%
Do you mind the energy consumption when you purchase new electric appliances?	yes	94,1%		88,9%	
Do you completely switch off an appliance with standby-function when you have finished using it?	yes	56,3%	66,7%	77,8%	55,6%
Do you wait until you have a full load before you use your washing machine?	yes	100%	94%	88,9%	100%

Interest in energy saving issues and satisfaction with the EAS service

As the following figure shows, are the attitudes of the pilot tenants regarding energy saving issues very positive. The majorities of EAS users as well as non-users have the opinion that the decrease of CO2-emissions is important for the protection of the environment. Therefore they are very interested in the energy consumption the possibilities of saving energy at home. In addition to that both comparison groups - users slightly more than non-users – are convinced that they should save more energy at home.

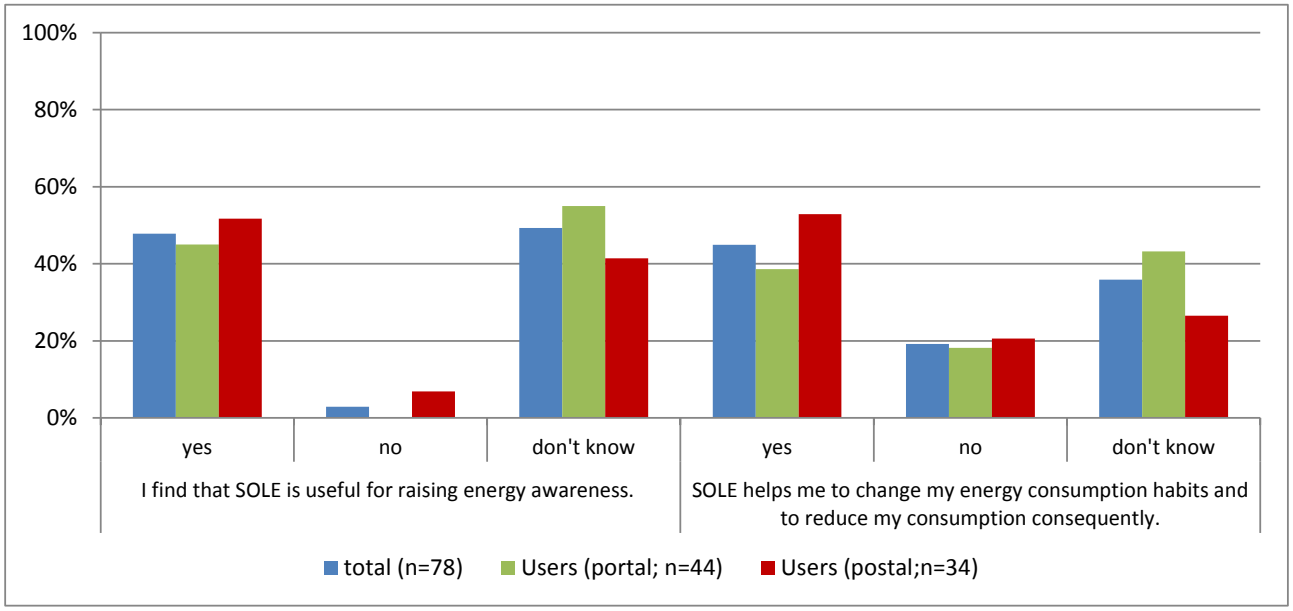
44% of the current non-users know the EAS but still don't use it.

Figure 4-158: Attitudes of users and non-users regarding energy saving issues (users n=48 to 53; non-users n=48 to 50)



In total 48% of all EAS users (45 % of all EAS tenant portal users and 52 % of all those tenants who receive the EAS information per postal letter) find the provided services SOLE very useful for raising the tenant's energy awareness. A similar number of users have already the opinion that SOLE helps them to change their energy consumption habits and to reduce their energy consumption. Obvious in the following figure is the high percentage of tenants who are still undecided. It is to assume that these tenants need further experiences with SOLE covering more than the first year after its implementation.

Figure 4-159: Assessment of the EAS



The results of the tenant survey analysis show that tenants in North Italy are characterized by a positive attitude regarding energy saving issues also before the introduction of the EAS system. Probably this is due to the fact that these tenants pay by themselves for their energy bills since there is no support from municipalities. For Social Housings tenants energy costs in North Italy represent a significant part of the family economic balance, so tenants take care about energy consumption. At any rate the consumption report could surely help improving energy savings. Energy “tips” for savings could give more correct information about some behaviour patterns. That will help to achieve already good savings results even if they are not as high as desirable.

Probably, as far as now, a huge reduction of energy consumption could be possible through the implementation of “external” and massive actions only – such as refurbishment of buildings or introducing the use of common electric appliances (e.g. common washing machines, all actions that currently some SH coops are investigating.

Otherwise, there is also a consistent part of users who are characterised by consolidated behaviour towards energy savings: they are not interested in energy problems, they only want *comfort*. More, other tenants are not able to “use” the dwelling in an energy-efficient way. All these issues lead that for North Italy pilot tenants training is necessary but it requires long times and “ad hoc” programs.

4.10 Westerlo

4.10.1 Background information

The Westerlo pilot site developed in the eSESH project an energy awareness service (EAS) as well as an energy management service (EMS).

As EAS a web portal is offered to the social tenants to check and control their energy consumption for heating, gas, hot water, electricity and cold water. For the purpose of motivation all interested tenants have been equipped with tablet-PCs. The consumption overview serves always as welcome page when starting to make use of the tablet-PC. The web portal offers the possibility to evaluate trends in energy consumption and behaviour and allows the tenants to compare their energy consumption in relation to other social tenants and similar household profiles. Additionally, the web portal offers the opportunity to set consumption objectives for the next year.

Figure 4-160: EAS web portal

Zonnige Kempen (ZK) has both individual and collective heating systems in place in its dwellings. The collective heating systems need special attention and monitoring as every change in performance of the systems has a multiplied impact on several households that depend on the heating system. As the collective systems are spread over 11 towns, the possibility for remote interaction with the systems will be included in the web portal for professional use (EMS). The second reason to implement EMS was due to the general concern to reduce energy consumption in social housing. At the starting point of the eSESH project, Zonnige Kempen had no overview on the energy behaviour of its tenants. The EMS offered to the technical staff at the social housing provider, enables ZK staff both to monitor heating installations (equipment) and social tenants (people). ZK requested a benchmarking tool in order to compare tenants with each other. In this way ZK staff can focus their actions on those tenants who are high consumers. The EMS system here is in fact used as a back-up EAS (if they don't do it themselves). Within the tool it is possible to select a group of similar tenants (all on one site, all collective, etc.) and compare them to each other. Next to that the common meters are to red out by the system, but since this had a lower priority. This is operational, but is only been used to calculate financial module in the EAS.

Important to understand the results of the eSESH-project for the Westerlo pilot site is that the eSESH – project is not a single experiment about energy awareness, but embedded in a complete energy and information strategy of the social housing housing company.

Table 4-71: The Zonnige Kempen energy saving philosophy

Zonnige Kempen (ZK), the involved social housing company in Westerlo, has a long tradition of raising awareness campaigns amongst their tenants regarding energy use. With respect to energy use in buildings they are early adapters of raising sustainability in their building stock. To increase sustainability ZK developed an own energy philosophy based on the 'TRIAS ENERGETICA'.

The TRIAS ENERGETICA exists out of three steps:

1. *Reducing energy demand by e.g. well insulated buildings, etc.*
2. *Using renewables to meet the reduced energy demand by e.g. thermal solar panels for hot water, etc.*
3. *Implementing efficient energy systems by replacement of inefficient individual system by efficient collective heating systems, etc.*

Next to the three first steps towards a sustainable building stock, which are necessary but insufficient, they added three additional steps to be taken into account to achieve success, a sustainable energy use in buildings.

4. *Monitoring, evaluating and optimization of control and installation*

   (It is not because efficient systems are implemented, they work efficiently, it can go wrong at the installation, use or the like)

5. *Informing and sensitisation of how to use these often new systems. It is necessary that people understand it to prevent energy to be spoiled.*

   E.g. an old lady received a dishwasher from her kids, but was used to wash directly after making it dirty. As we visited her, we noticed she put the three dirty cups after our visit directly in the dishwasher and turned it on. The reason we visited her was an increased water and electricity consumption; the explanation was found with this observation. To prevent this kind of mistakes it is necessary to inform tenants about the building they live in.

6. *Communication about the experiences, both negative and positive.*

   As ZK is often an early adapter of new technologies, within a larger social context it is necessary to communicate successes both also less successful experiences to learn from this for future deployment. In this way the experiences in the older building stock will improve the results for the new building stocks. ZK takes also initiatives to exchange experiences with other housing companies, companies, research institutes and so on.

As can be understood, the eSESH project fits well in the philosophy of ZK and was a chance for ZK to improve the effectiveness of their sensitisation and awareness campaigns.

As will be illustrated with the baseline data, the average energy use by the tenants of ZK is low compared to the Belgian average, as a result of the attention paid by ZK to informing their tenants about energy use. However, nevertheless the good results for the average tenant, some tenants, the 'high consumer - HICs', still show high energy consumption.

With the eSESH project ZK aims to provide their tenants a tool to get more control on their energy consumption themselves (EAS) and to have the means to detect the 'High consumers' on time to focus their awareness campaigns more directly to these tenants (EMS). ZK does this from a social interest, but also because these tenants are likely to have high energy costs, which will prevent them to pay rent in time.

Tenant information and trainings have been carried out beginning at the end of 2011 – already before pilot operation start in January 2012.

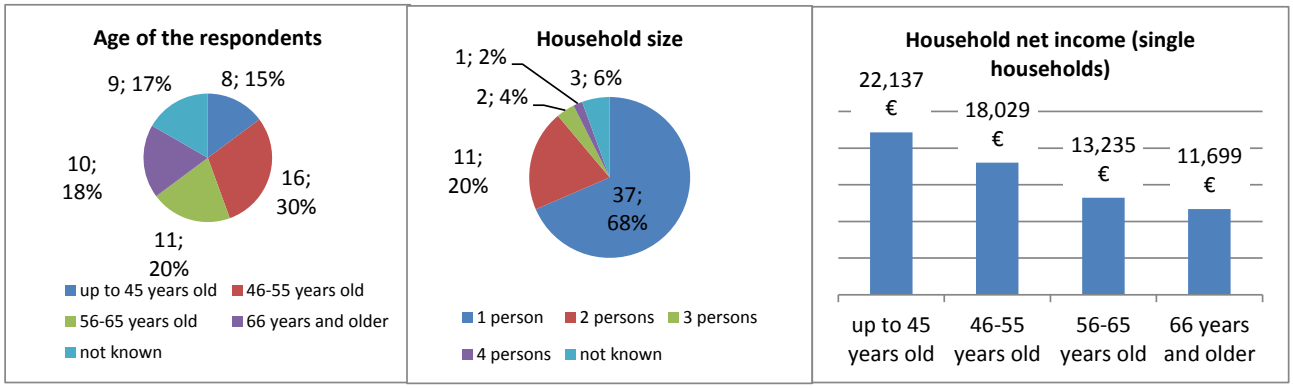
As shown in the following table 121 dwellings were in total involved in the pilot. The following analysis has been carried out with the dwellings of Schransstraat (and Netestraat) only because for most of these dwellings baseline data are available and the tenants live in are the same for both comparison periods. In Kapelaan Franklaan there are newly constructed buildings without measured baseline consumption.

Table 4-72: Overview of the number of buildings and dwellings involved in the Westerlo pilot

Site	Pilot site name	Number of buildings involved	Number of dwellings involved
Westerlo	Netestraat	1	1
	Schransstraat	5	53
	Kapelaan Franklaan	8	67

The pilot tenants in Westerlo mainly live in single households. The older the tenants live in a single household the smaller is the available household net income. In ten of the multi-person-households live children (< 18 years old).

Figure 4-161: Socio-demographic characteristics of the pilot tenants

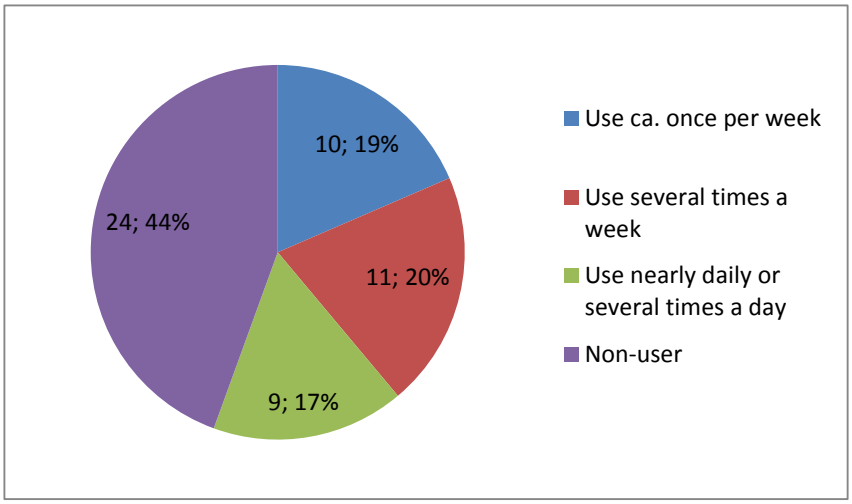


The average occupancy of tenants is 12.8 years. A quarter of the tenants live already 20 years up to 33 years in ZK dwellings.

According to the 'energy saving philosophy' all tenants were visited by an energy coach. 30 of the total 54 pilot tenants (56 %) use the EAS regularly. The use frequency varies from a weekly use up

to several times a day. On average tenants logged-in 54 times related to the three-month observation period (Oct to Dec 2012).

Figure 4-162: Distribution of EAS web portal users and non-users in Westerlo

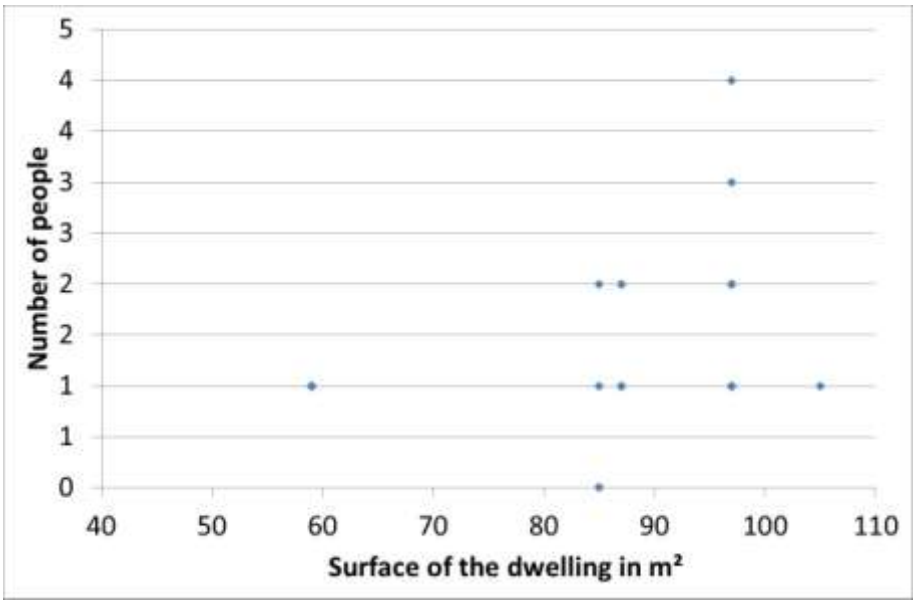


4.10.2 Results of consumption data analysis

In Westerlo electricity, heating and water consumption have been measured in 121 dwellings. The electricity is used for household appliances and lighting. As described above the following analysis focusses on the specific site Schransstraat, which is composed by 54 dwellings. Concerning water the implementation succeeded in only a small number of dwellings. As a result water consumption is not analysed here.

The number of people per dwelling and the size of the dwellings are important elements to be considered in the analysis. The figure below shows that in Westerlo dwellings with surfaces of around 90m² with one to four people living in have been included in the analysis.

Figure 4-163: Number of people in the dwelling related to the size of the dwelling in m²



Before analysing the data, it was necessary to cleanse it in order to take into account the change of tenancy as well as some incoherencies or periods of absence of the tenants. In these cases, the dwellings were excluded from the analysis. The dataset analysed represents nearly 85% of the whole dataset.

Table 4-73: Description of the cleansing step

Cleansing			
Data	Site	Number of dwellings	
		Before cleansing	After cleansing
Electricity	Total	55	30
Heating (for 8 dwellings, other usages: water heating and cooking are included)	Total	55	44

For calculating the savings a pre-post comparison has been used. In view of the eSESH service operation start in January 2012, the pre-post comparison is based on the analysis of the evolution of the consumption figures before the implementation of the service (baseline period: 01/01/2011 – 31/12/2011) and after the implementation of the service (reporting period: 01/01/2012 – 31/12/2012). The durations of the baseline and the reporting periods, 12 months, enable to have a good consistency of the data.

Global results of consumption data analysis

The global calculation of savings is shown in the following table. Therefore total heating savings of nearly 7% has been observed. No net savings could be calculated for electricity.

Compared to the heating saving targets of 9% regarding individual heating system and 13% regarding collective heating system (see evaluation planning deliverable) the achieved savings seem to be below expectations. But as described earlier, ZK aims to use the eSESH-tool for especially motivating ‘high consumers’ to reduce energy consumption. These are the ‘Top Five’ consumers in 2011. As the following analysis will show, that group achieved higher average savings - 11% heating and nearly 6% electricity savings. From this group only one tenant did not use the portal himself.

In addition to that, there are already some control optimisations for the collective heating introduced. These are especially limitations regarding settings.

Table 4-74: Overview of global results in Westerlo

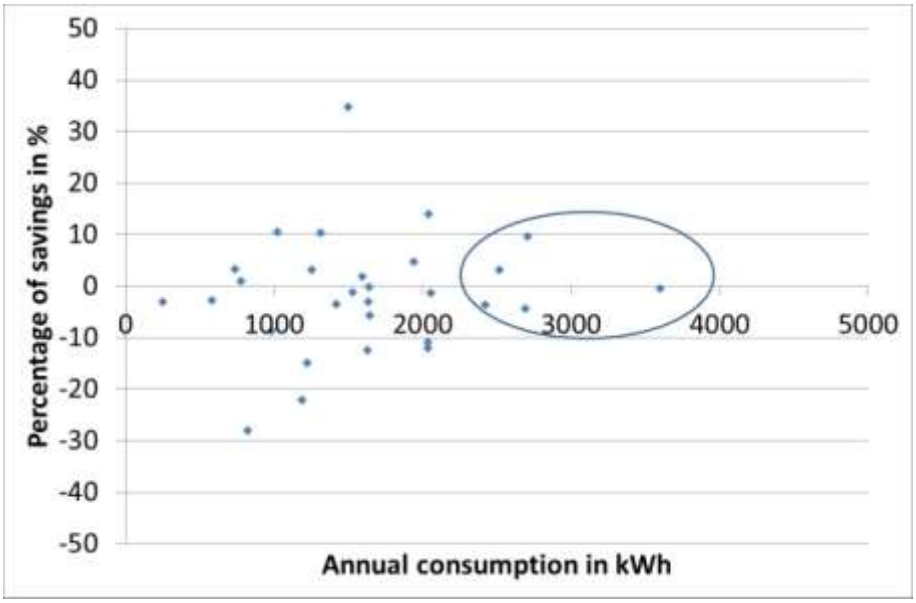
Key data		
	Electricity	Heating (for 8 dwellings, other usages: water heating and cooking are included)
Number of dwellings	30	44
Surface area (average)	78	83
Number of people (average)	1,27	1,25
Global Results for the dataset of dwellings		
	Electricity	Heating (for 8 dwellings, other usages: water heating and cooking are included)
Savings (%) - eeMeasure (weighted)	-	6,60%
Saving (kWh/yr or m3/yr) - eeMeasure	-	12 056
Carbon Dioxid Reduction in kgCO2/yr - eeMeasure	-	2 857
Financial Saving (€/yr) - eeMeasure	-	844
Consumption Before Intervention (kWh/yr - average)	52 206	183 706
Results (per dwelling, per people or per m²)		
	Electricity	Heating (for 8 dwellings, other usages: water heating and cooking are included)
Consumption Unit	*(kWh/m².year)*	*(kWh/m².year)*
Consumption - Before intervention (annual average)	22,3	50,6
Consumption - After intervention (annual average)	22,8	46,7
Consumption Unit	*(kWh/dwelling.year)*	*(kWh/dwelling.year)*
Consumption - Before intervention (annual average)	1 740	4 175
Consumption - In the same country* (annual average)	2724*	-
Savings	-	274
Carbon Dioxid Reduction in kgCO2/dwelling.yr	-	65
Financial Saving (€/dwelling.yr)	-	19
** See references*		
The figures given for the Carbon Dioxid Reduction and the Financial Savings are indicative. They are based on the coefficients related to Gas.		

Electricity

For electricity, it is important to compare the levels of annual electricity consumption per m² with the Belgian national level. Indeed, the average level of consumption of the dwellings analysed on the site of Schransstraat (1,740 kWh per year) is very low compared to the national level (2,724 kWh per year). Thus, the pilot tenants already consume less than the national average and as a consequence so that there possibilities limited in terms of feasible savings.

Even if no net electricity savings could be observed, it is interesting to study the relation between the percentage of savings and the annual electricity consumption.

Figure 4-164: Percentage of savings (+ values) related to annual electricity consumption in kWh



The chart above shows that a significant number of tenants (40%) achieved electricity savings. In a context of increase of the electricity consumptions (the number of electrical appliances always increases) this result is encouraging. Even if no net savings have been observed, the global consumption doesn't increase.

Besides, this graph highlights good results from the high consumers. Indeed, as described earlier, ZKs tries to reach first these high consumers. If considering the top five consumers in 2011 (who consumed more than 2500kWh per year) it can be observed that one of these tenants made 17% of savings. Considering all 5 high consumers altogether the percentage of savings is equal to 5.9%. In this group, only one tenant did not use the portal

Thus, the results for electricity have to be linked with the current Belgian level of consumption. Moreover, this positive trend for electricity savings of high consumers is also the result of the intense awareness campaigns executed by ZK as described earlier. Within the survey it could be noticed that all tenants were very well aware of dark consumption and most of them used switches to prevent stand-by losses. In addition to that most of the tenants use saving bulbs for lighting due to efforts of the city and ZK. In the survey tenants reported that they shut everything down after leaving, sometimes even before they has been asked while referring to meetings held with the city and ZK.

For this reason, it is not to be expected to find more savings with the average tenant as the consumption is already lower than Belgian average.

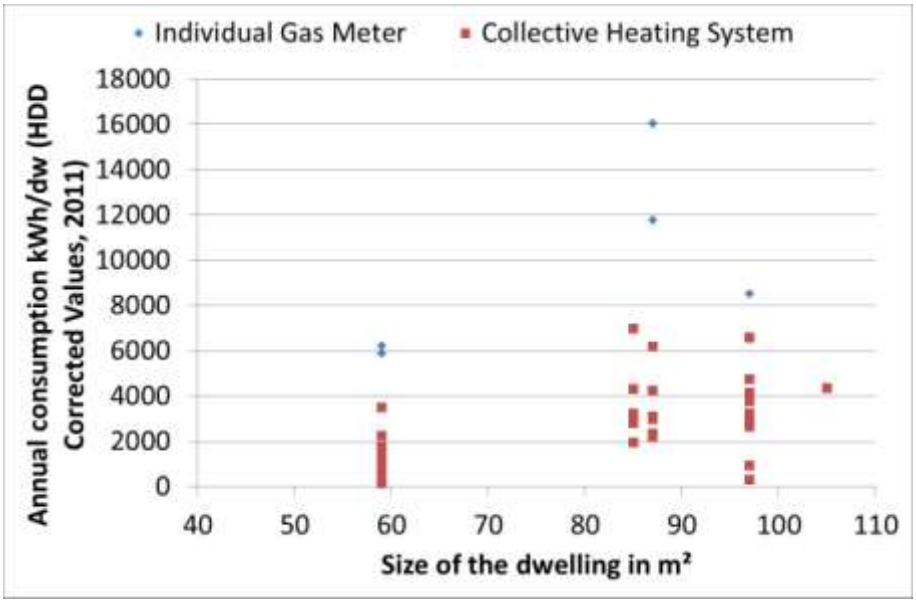
Heating

Among the five buildings of the site of Schransstraat four buildings are equipped with a collective heating system. The fifth is equipped with an individual heating system. That means these tenants have an individual gas meter to meet their heat demand for space heating, hot water and mostly cooking. For the tenants in the other buildings a caloric meter reads out the heat needed for space heating.

The calculation of heat energy savings led to the global result of 6.6% savings. This number is lower than expected since the average heat demand is already low (an average of 43 kWh/m² for space heating and 120 kWh/m² for gas consumption) due to the fact that the buildings have been recently renovated to low energy buildings, including the incorporation of solar heating for domestic hot water production. This is done for all buildings.

The following graph shows the annual gas consumption related to the size of the dwelling. As expected the consumption of the individual gas meters is higher than the consumption measured related to the collective heating system (even if the gas usages are not the same).

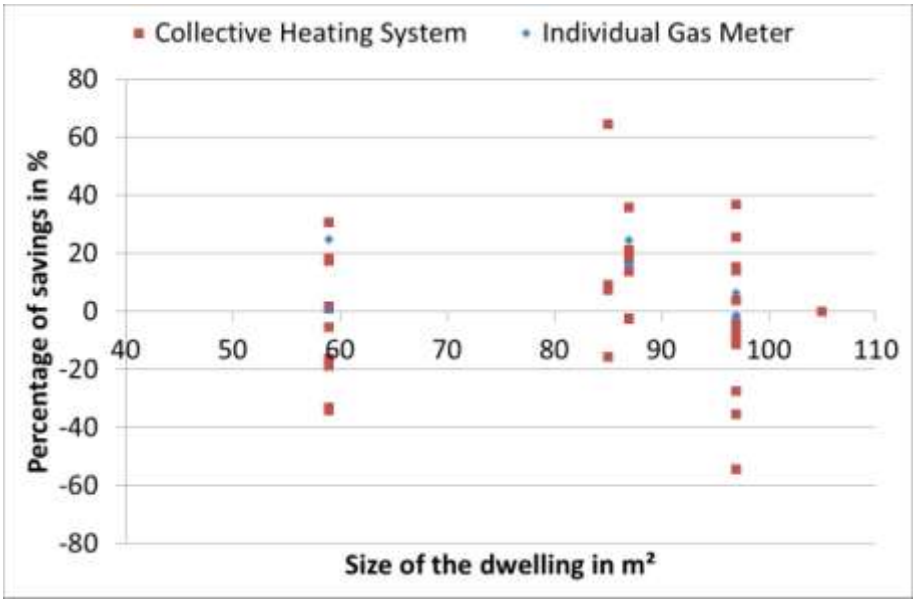
Figure 4-165: Annual Consumption (in kWh) related to the surface of the dwelling in m², during the baseline period



It was further interesting to study the relation between the percentage of savings and the size of the dwelling.

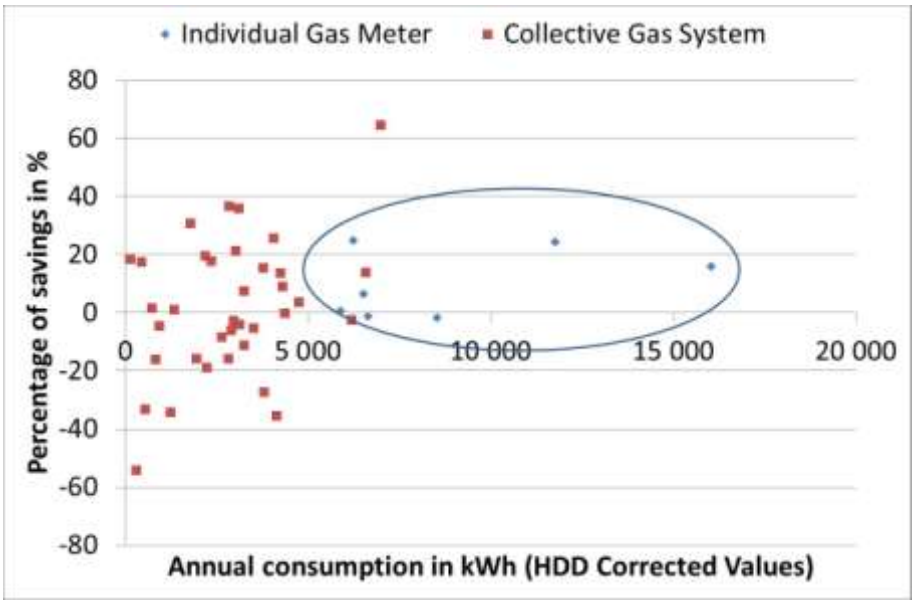
It appears in the following figure that more than 50% of the tenants achieved savings. Thanks to the graph below, it can be observed that there is no correlation between the size of the dwelling and the percentage of savings. A comparison between the dwellings equipped with an individual gas meter and a collective heating system shows that, on the contrary to the second ones, nearly all the dwellings equipped with individual gas meters made savings. This could mean that savings on usages like cooking or hot water are easier to achieve than for space heating.

Figure 4-166: Percentage of savings (+ values) related to the surface of the dwelling in m²



In the following figure the surface of the dwelling has been replaced by the annual electricity consumption of the baseline period. The graph shows a tendency of high consumers to achieve comparably higher savings. A calculation of the savings based on these high consumers led to a promising global result of 11% savings.

Figure 4-167: Percentage of savings (+ values) related to the annual consumption in kWh



Comparison between Users and Non-Users of the service

The analysis of the tenants who used the service (use of the web portal) led to the following distribution:

Table 4-75: Distribution of users and non-users in the consumption dataset and results

Comparison between users and non-users					
		Electricity		Heating	
Total of dwellings	Users	18	60%	24	55%
	Non Users	12	40%	20	45%
	Total	30	100%	44	100%
Surface per dwelling	Users	75,72		85,00	
	Non Users	81,53		79,60	
People per dwelling	Users	1,33		1,38	
	Non Users	1,17		1,10	
Average Annual Consumption 2011	*Unit*	*kWh/(dw.year) in 2011*		*kWh/(dw.year) in 2011*	
	Users	1849		3824	
	Non Users	1511		4122	
% of dwellings which made savings	Users	-		45%	
	Non Users	-		45%	
	Total	-		45%	
Savings (%)	Users	-		5,7%	
	Non Users	-		9,4%	
High Consumers	Users	4		3	
	Non Users	1		2	
High Consumers Savings		5,9%		11,0%	

As no net savings are calculated for Electricity, the differentiation between users and non-users is not very representative. Nevertheless, it appears that the service had a positive impact on the high consumers. Indeed, these high consumers made nearly 6% of savings. Four of these tenants used the service regularly.

Concerning heating, among the 5 highest consumers, a percentage of savings of 11% has been measured, which is an encouraging result. Moreover, when considering the users among the highest consumers a global percentage of savings of nearly 15% has been achieved.

Concerning the whole sample, the distinction between users and non-users doesn't show an impact of the service on the behaviours. But bearing in mind the 'energy saving philosophy' of ZK that result must be related with the intensive awareness campaign which impacted all pilot tenants.

4.10.3 Results of tenant survey analysis

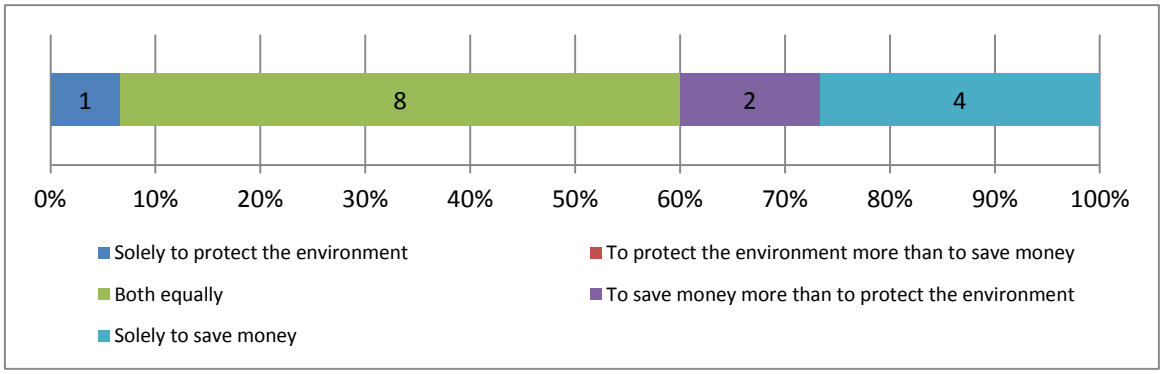
The Westerlo pilot site carried out one tenant survey at the end of the reporting period in December 2012. In total participated 17 of the 54 pilot tenants (31%) in the telephone interviews realised by ZK staff. The questionnaire focussed on the motivation to save energy, the equipment with electrical appliances and its usage, the average indoor temperature, the assessment of EAS components and the reasons for using or non-using EAS.

Among the survey sample are 8 EAS users and 9 non-users. In view of the small sample size and the above described energy awareness campaign which is addressed to all pilot tenants (e.g. all pilot tenants were visited by an energy coach) a differentiation of EAS users and non-users in the following is not appropriate resp. only partly done.

Motivation to save energy

To save money is for the majority of respondents a driver for saving energy. Nevertheless, for 11 of 15 respondents the protection of the environment also serves as a motivator. The lower the household income, the higher the interest in saving energy in order to save money (4 tenants 'solely save money': average net income 13,312 €, 8 tenants 'both equally' 16.283 €).

Figure 4-168: Responses to the question "Which motivates you more to save energy – protecting the environment or saving money? (n=15)



Equipment with electrical appliances and usage

The large home appliances have the main impact on domestic electricity consumption. Based on the results of the tenant survey it seems that the equipment of the respondents with electrical appliances is lower than normal:

- Only one of the 17 respondents has a dish washer.
- Six of the 17 respondents have a dryer.
- 12 of the 17 respondents have a washing machine.
- 7 of the 17 cook electrically.

That corresponds to the above statement that the Westerlo pilot tenants have an electricity consumption average which is less than half of the Belgian average.

Table 4-76: Availability of large home appliances, its efficiency labels and use frequency

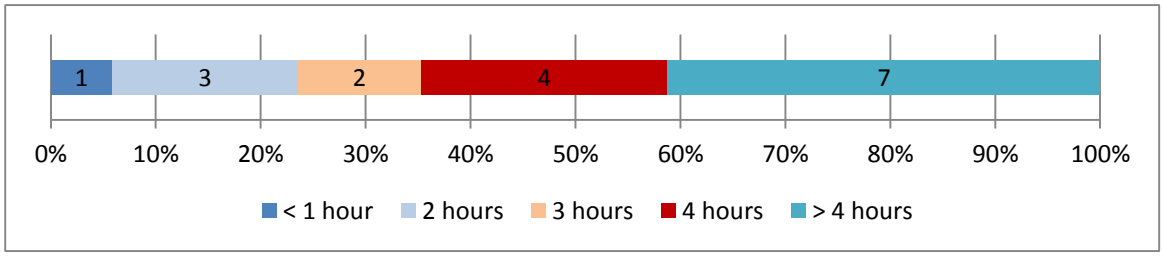
Appliance	Availability		Efficiency label	Use frequency
Washing machine	yes	12	- A-Label: 6 - no A-Label: 1 - not known:5	- once per week: 3 - 3 times per week: 6 - daily: 2
	no	5		
Dryer	yes	6	- no A-Label: 2 - not known: 4	- 3 times per week: 1 - once per week: 4
	no	11		
Dish washer	yes	1	- not known: 1	- 3 times per week: 1
	no	16		
Fridge (without freezer)	yes	8	- A-Label: 4 - no A-Label: 2 - not known: 2	
	no	9		
Freezer	yes	6	- A-Label: 3 - no A-Label: 2 - not known: 1	
	no	11		
Fridge-freezer-combination	yes	9	- A-Label: 2 - no A-Label: 1 - not known: 6	
	no	8		
Electric cooker	yes	7		
	no	10		

Often the appliances have a low energy label or the label is not known which also suggests that it must be an older one. In view of the low income of social housing tenants their possibilities of replacing them by better ones in order to save energy are very restricted.

Except one tenant who reported on three available TVs, the other households use one TV. Seven of 17 respondents reported that they use it more than 4 hours per day.

The majority of respondents (n=12) switch the TV totally off when finishing TV viewing, four tenants use the stand-by function.

Figure 4-169: Average TV viewing time (in hours per day)



Further equipment the tenants reported is:

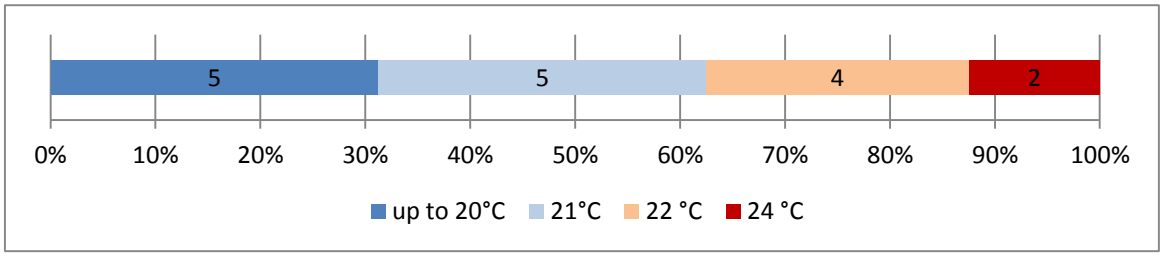
- DigiBox (converter for digital TV): available in 9 households, thereof three switch it totally off after user, six keep it in stand-by
- PC, laptops: also available in 9 households
- Microwaves: 4 of 17 households

All of the 17 respondents switch off the light when they leave the room.

Average room temperatures

It is not known if the tenants reduced their indoor temperatures as a result of the awareness campaign, but it becomes obvious that the reported average room temperatures are on a heat energy efficient level. Only two of the 17 respondents choose temperatures higher than 22 °C. That corresponds to the above statement that the heat energy consumption of the Westerlo pilot tenants is significantly lower than the Belgian average.

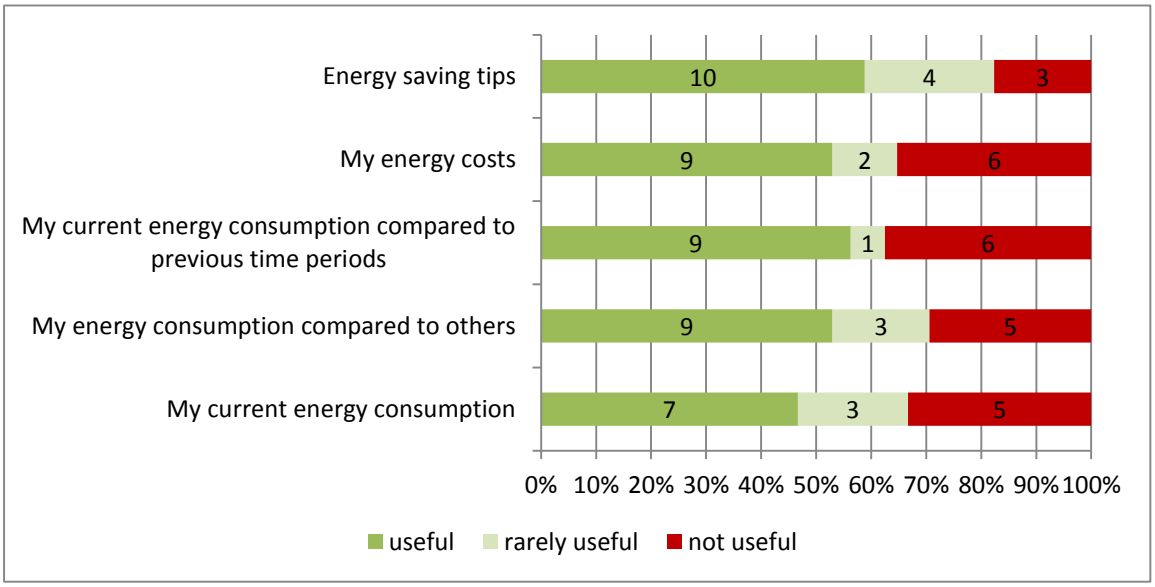
Table 4-77: Reported average room temperatures



Assessment of EAS

The Westerlo EAS contains various information regarding energy consumption figures including reference values for historical or average comparisons and energy saving tips. The questions if such information is useful or not have been addressed to all survey participants - equal if they were already users or not. As the following figure shows most of the respondents assessed the EAS components as (rarely) useful. Especially energy saving tips are for the majority of respondents of interest.

Figure 4-170: Usefulness of several aspects of EAS



Reasons for EAS use or non-use

All EAS users now keep an eye on their energy consumption (except one user tenant who didn't respond to that question). Two of the 8 users in the sample emphasised their increased awareness as a result of the EAS use. The reasons for using are as follows:

- 6 of the 8 users want to reduce their energy costs.
- 5 of the 8 users want to know their annual costs.
- 5 of the 8 users want to get energy saving tips.

The reasons for non-use were reported from only five of the 9 non-users in the sample. Thereof 3 are interested in energy saving and tips how to do that but they prefer brochures and magazines. 4 of them know the EAS service, but are also in the future not interested in using EAS which is due to their disinterest in internet use. Two of them belong to the oldest age-group.

5 Conclusions and outlook

The eSESH energy awareness services (EAS) and energy management services (EMS) have proven to be appropriate instruments which allow to significantly save energy even in 'difficult' contexts like social housing further described above and below.

The eSESH project equipped 2,666 dwellings[20] in social housing contexts with the eSESH EAS / EMS services. These were aimed to support tenants in saving energy in different social housing dwellings in 10 pilot sites all over Europe. This enabled 5,865 users to make use of these services which is a figure above the original plan of slightly more than 5,000 users.

With an overall saving of heating energy consumption of 9% across all pilot sites the eSESH project exactly met its target. This presents a significant achievement considering the outstanding importance of reducing energy use for domestic heating, which accounts for more than two third of energy consumption in the residential sector.

Targets were not fully met for electricity (target: 8.4%; savings achieved by end of project: 5.9%), hot water (target: 11.8%; savings achieved: 7.4%) and cold water (target: 12.3%, savings achieved: 5.9%). There are good reasons to believe, however, that consumption in these areas will be further reduced in the coming months as a result of EAS/EMS implementation; this is because the tenant survey has shown that a large share of pilot participants are in a process of changing their daily behaviour in order to save more energy – a process that will continue for some time.

There are huge differences across the pilot sites which reflect the different contexts and framework conditions under which the services were implemented, introduced and operated. With 32% and 14% energy consumption reduction through the use of the eSESH service the pilot sites in Catalonia and Karlsruhe achieved the highest savings in heating energy consumption. For electricity the highest savings can be observed in Extremadura with almost 12%. Finally, the pilot site Moulins with its attractive TV-based tenant user interface demonstrates that also for hot and cold water large savings can be achieved. Here the savings amount to an impressive 24.3% for hot water and 12.5% for cold water. While the average energy savings in eSESH are below the European Commission target of 15%, those of the top performing pilot site reach beyond these very ambitious targets.

These achievements need to be seen against the background of a very short operation phase of just one year on the one hand and a very specific target group - social housing tenants - on the other. In the course of the project it became apparent that in order to achieve even higher and sustainable energy savings a longer operation period would be required since the eSESH service requires a longer familiarisation phase for the tenants to make best use of it. The pilot sites also unanimously report about the substantial effort needed and time required to attract tenants to service use. This time had not been available within the eSESH project but would be needed for an even more successful and wider eSESH service deployment and roll-out. One also needs to bear in mind that the target group of social housing tenants offers several challenges which makes it more difficult to attract them to eSESH service use. Finally, we identified that the tenants in the eSESH pilot sites are already rather energy cost conscious and belong to the group of people who

[20] This number is related to the cleansed dataset. In total, 3,722 pilot dwellings were involved in the project, whereof 3,662 have been equipped with successfully running metering equipment. The latter figure has mostly been considered when analysing the impact of EMS.

- for different reasons including low income levels, below average dwelling sizes and a rather small number of energy consuming appliances - belong to the group of low energy consumers already. This can be illustrated by examples from several pilot sites where for instance in Karlsruhe the average national heating consumption is 162 kWh/m2/year compared to 63 KWh/m2/year of the eSESH service users. In other pilot sites the situation is comparable.

It is against this background that the savings in eSESH can be judged as a real success and that it is very unlikely (for reasons given) that for these tenant groups even higher energy savings than those already achieved in eSESH can be achieved. However, this also allows for a conclusion that other tenant groups coming up with different characteristics like for instance higher education and income – and therefore likely to belong to the group of higher energy consumers - could easily save energy at higher levels and probably between 10-20%.

Many of the social housing tenants are not very familiar with the use of ICT or do not have an internet access which is a prerequisite for EAS use through an online portal. Policy may want to become active in addressing this issue first and foremost since this is to be seen as an important means to an end when it comes to more widespread energy saving throughout Europe. The eSESH case of Westerlo has shown that by handing over a tablet PC to tenants for free - which implies a very small investment for the social housing company – this can be achieved already.

The eSESH project has also shown that it is of utmost importance to embed the introduction of eSESH EAS services in an overall energy awareness campaign in order to be successful and achieve its objectives. The importance is illustrated by the fact that in several cases not only the eSESH service users but also those tenants addressed by an awareness campaign but not becoming service users afterwards also developed an improved energy saving behaviour which in some cases resulted in even higher savings than those of the service users.

Using such an approach increases the likelihood of success which in eSESH has been confirmed by the results from the tenant surveys which revealed positive changes in energy consumption behaviour of tenants when using the eSESH service. Furthermore tenants using the service express high levels of satisfaction with the eSESH service.

As already demonstrated in several pilot sites (e.g. Westerlo, Angers, Extremadura) a special focus of activities should be on the high energy consumers. For instance in the Extremadura pilot site this group achieved electricity savings of more than 17% compared to 5.4% of those classified as low energy consumers. Similar figures can be observed in other pilot sites. The energy saving potential of low energy consumers (e.g. as in Frankfurt and other pilot sites) is limited, especially when they already consume significantly less energy than the national ‘average’ tenants (see above).

Cooperation with and involvement of utilities and energy providers in energy awareness raising activities like those demonstrated by eSESH is essential in order to get access to energy consumption data of tenants on which the entire service is based. The pilot site Linz with the direct and very active involvement of the utility LINZ AG right from the start can be seen as a very successful example and good illustrations of how best to proceed. On the contrary the Moulins and Extremadura pilot sites demonstrate the problems which need to be addressed and tackled when utilities are not directly involved. In the former case this delayed the process for more than a year. In the latter the solution required a political intervention at regional policy level which also requires

substantial effort to be spent. The lessons learned from these experiences have been taken on board an integrated in the eSESH Guide for replication (see D8.3).

The ideal constellation of service provision is a combined offer of EMS and EAS with the EMS likely to achieve substantial savings through an improved management and operation of the energy systems and grid management. Frankfurt can be taken as one example for this where the EMS for the heating system resulted in a 9% reduction of energy consumption already for the summer period, i.e. outside the heating period. This bears the potential of significantly higher savings for a whole year which could easily reach 15-20%. The EAS offered on top resulted in an additional saving of 4.1% and up to 10% depending on the choice of baseline period. The case of Solingen is another interesting example where the use of the EMS has been extremely successful with substantial savings leaving almost no room for any further savings through the use of an EAS. Compared to the heat demand specified in EnEV the eSESH pilot site Solingen achieved a heat energy consumption (55 kWh/m2*a) which is already 14% lower than the calculated heat demand (64 kWh/m2*a). This is already a large success but becomes even more positive when comparing it to similar settlements but not using the eSESH service which have been used as control groups. That comparison shows impressive savings of 21% up to 38% which underlines the success of the eSESH EAS and EMS without which this positive result would not have been reached.

All eSESH pilot sites decided to continue to offer and expand eSESH service offering in the future and to continue their awareness campaigns, energy coaching and related activities. That will give the opportunity to validate the positive impact of EAS and EMS which could be demonstrated already after a one year operation phase and obtain reliable results regarding its long-term effects. Furthermore, the description and use of the ‘success story’ of the eSESH project in these campaigns are likely to motivate reluctant tenants to make use of the service resp. to engage them in energy-efficiently lifestyles and reducing their overall resource consumption. eSESH has shown the way!

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