



# SAVE@Work4Homes

Supporting European Housing Tenants in Optimising Resource Consumption

## Final Report



[save.atwork4homes.eu](http://save.atwork4homes.eu)

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## EXECUTIVE SUMMARY

Helping tenants optimise their energy-related behaviour is essential if significant energy savings are to be achieved in European social housing. Information gained in the SAVE@Work4Homes project confirmed that the potential for energy saving is very large: many tenants appear to be largely unaware of ways in which they may be wasting heat delivered to the home. Consumption-based billing is likely to be little help in combating waste or reinforcing energy-saving action by tenants as there is often a long delay between any change in behaviour and feedback. Consumption based billing for heating in Germany is annual, and many energy utilities continue to read meters irregularly and at long intervals. Given this lack of appropriate feedback, even tenants whose awareness of environmental and energy issues is high have great difficulty in translating their intentions into appropriate action. Tenants surveyed consider that social housing companies could help by giving them more accurate information about their consumption and advice on how to reduce it

The objective of the SAVE@Work4Homes project was to develop and test a complementary set of viable and effective services, Energy Awareness Services, meeting tenants' requirements for timely feedback on their energy-related behaviour.

These services were based on a "toolbox" of components:

- automatic monitoring of consumption and transmission of consumption data in respect of heating costs;
- analysis and presentation of consumption data for access by tenants via Internet or other methods (PDA, paper);
- self-assessment scheme to assess the success of residents of a housing unit in reducing their energy consumption;
- improvement of heating controls and feedback to users of heating settings;
- tenant energy portal (internet).

The Energy Awareness Services were designed using the results of research into tenants requirements. The designs selected were those which promise to assist tenants in adapting their behaviour to more efficient use of energy. The services were implemented in six pilot sites managed by six social housing companies in Europe and tested in the period 2007-2009, including in particular the 2008-2009 heating season.

The evaluation process demonstrated that in many cases, savings were achieved. For example savings of heating energy in Karlsruhe were very significant with a rate of heating savings close to 10% (16% of for the experimental group against 4% to 7% for the two control groups). Services were provided for other energy types, especially electricity, and also for cold water as another natural resource. The evaluation results can be found on the project website.

A guide to service introduction, presenting the SAVE@Work4Homes services and intended for the European landlords, is also available on the project website. A video of the project has been produced to facilitate the dissemination of the results to all the European social housing organisations and to stimulate them to

develop similar services to their tenants. The main documents of the project are also available in the database of the POWER HOUSE Europe project ([www.powerhouseeurope.eu](http://www.powerhouseeurope.eu)) which is dedicated to the dissemination of all European projects interesting the social housing companies.

The evaluation of tools developed and implemented during the project showed that changes in behaviour can be achieved. The project also showed the importance of ensuring the information given is the information most relevant to helping tenants change their behaviour and save energy and cost.

# 1. INTRODUCTION AND PROJECT SUMMARY

## Introduction

Against a background of strong evidence of accelerating global warming and continuing over-exploitation of natural resources it is clear that any savings of any form of consumption of energy or other natural resources should be tackled urgently.

The residential and tertiary building sector is a key target, accounting in Europe for 40% of energy consumption (27% in residential). Many measures to address savings in the sector are in progress across the EU; however, many only apply to new building, which is a small fraction - around 1% - of total stock and will have limited effect on overall energy consumption. Even if a factor 4 improvement of energy consumption in new stock were achieved, over 20 years this would effect an average reduction of only 12.5% across all stock and would leave the situation of tenants living in the old dwellings unchanged.

The cost of further refurbishment of existing stock can be very high. A minimum of € 20,000 per dwelling is necessary to reduce energy consumption by a factor of 2 from 160 kWh/m<sup>2</sup> - typical of social housing stock which has been partly retrofitted - to 80 kWh/m<sup>2</sup>. It is currently not possible, due to limited finance and a lack of qualified professions, to treat more than 2% of the stock per annum. At this rate, the reduction of energy consumption in the stock will only be 20% at the end of a 20 year period and more than the half of the tenants will continue to live in the same conditions – if not worse as a result of energy price increases. In the social housing sector, tenants' incomes have been severely affected by fuel price increases and the capacity of the tenants to absorb the additional costs of energy efficiency measures is particularly low.

Given this picture, one has to consider urgently all measures which in the short term can be implemented across the entire stock. The measures have to be financially acceptable to parties that will have to contribute (state, region, local authorities, social housing companies and tenants). Energy consumption does not depend only on the thermal efficiency of the walls and the efficiency of some equipment, but also on the behaviour of the people living in the dwellings.

These considerations led to the six social housing companies making up the @Work4Homes consortium applying to the European Commission's SAVE programme to assist them in bringing new Energy Awareness Services to their tenants. The consortium @Work4Homes has regularly worked together to develop and evaluate new services for their tenants, and has applied in the past for assistance from the European Commission - e.g. to improve accessibility to the Internet for tenants, to enhance communication between their staff and tenants or to introduce modern IT security management.

Changing tenants' behaviour is an essential component of achieving significant energy savings in social housing. Information gained in the project confirmed that the potential in energy savings is very large, in particular, as many people appear to be largely unaware of the many ways in which heat can be wasted in the home. Consumption-based billing for heating, which is prevalent in Germany, is insufficient to help tenants combat waste, because the time between the energy saving action by the tenant and the bill is too long (more than one year).

Even tenants whose awareness of environmental and energy issues is high have many difficulties in translating their thoughts into action without appropriate feedback. Tenants surveyed consider that social housing companies could help by giving them more accurate information about their consumption and advice on how to reduce it

## **Project summary**

The goal of the SAVE@Work4Homes project was to develop and test a complementary set of viable and effective services, Energy Awareness Services, which meet tenants requirements for timely feedback on their energy-related behaviour. These services were based on a "toolbox" of components covering automatic monitoring of consumption and transmission of consumption data in respect of heating costs; analysis and presentation of consumption data for access by tenants via Internet or other methods (PDA, paper); self-assessment scheme to assess the success of residents of a housing unit in reducing their energy consumption; improvement of heating controls and feedback to users of heating settings and provision of tenant energy portals.

The Energy Awareness Services were designed using the results of research into tenants requirements. The designs selected were those which promise to assist tenants in adapting their behaviour to more efficient use of energy. The services were implemented in six pilot sites managed by six social housing companies in Europe and tested in the period 2007-2009, including in particular the 2008-2009 heating season.

All platforms have the same goals and objectives, but the implementation of these services can differ from one country to another for legal or cultural reasons and even in the same country for local, organisational or, simply, competitiveness reasons.

The project participants are empirica Communication and Technology Research, Bonn, Germany; Habitat Territoire et Conseil, Paris, France; Le Toit Angevin, Angers, France; Moulins Habitat, Moulins, France; Nassauische Heimstätte, Frankfurt, Germany; the Northern Ireland Housing Executive, Belfast, UK; Stadt und Land, Berlin, Germany; Union Social Habitat, Paris, France; Volkswohnung, Karlsruhe, Germany; Institut Wohnen und Umwelt, Darmstadt, Germany and DomData SP. z.o.o., Posnan, Poland.

## Social housing tenants and energy saving potential

### Energy-related attitudes and behaviour of tenants

In the SAVE@Work4Homes project the tenant's perspective occupied a central position. First of all, research into tenant energy consumption behaviour, attitudes and information requirements was essential for selecting options in respect of the Energy Awareness Service components, their design and specification. At the beginning of the project therefore a broad tenant survey<sup>1</sup> was carried out which covered the responses from 2,637 tenants living in the building stock of the six participating housing providers. The most relevant findings were:

Most respondent tenants of social housing were 60 and more years old (39%). In general they lived on low income levels and/or social security benefits. 46% of the households had a monthly net household income up to 900 €. Often they had no private access to a computer (61%) and no access to internet (63%).

Most tenants were worried about the climate change (57%) and felt themselves as being aware of environmental issues (60 % "very much aware" and "quite aware"). Saving money (27%) motivated tenants more to save energy than protecting the environment (10%). For the most tenants (63%) both aspects were similarly important.

Most tenants valued their own energy consumption as medium (58%). On the other hand the collected data showed a set of possibilities to tap the full potential of energy saving - for example improvements in ventilation and heating behaviour. Primarily in France had to be considered that a lot of tenants (15%) cannot adjust the setting of their heating/radiators by themselves.

Although most tenants felt well informed about environmental issues in general, (63% "very well informed" and "fairly well informed") they otherwise described gaps in knowledge about the consumption of energy in their flats/houses and about the possibilities of saving energy there. Up to now they got information from TV (77%), newspapers (62%) and brochures (50%), but often they valued these channels as insufficient in order to satisfy their information need.

Most tenants were interested in a service which gives an exact overview of their energy consumption and hints about how to save energy. Tenants were mostly interested in current consumption figures (74%) and information about how to save electricity (77%), water heating (73%) and space heating (72%). Mostly they preferred pamphlets (86%) because for the lack of private computers or notebooks with an internet access.

Most tenants wanted to use it regularly, but did not want to pay (75%).

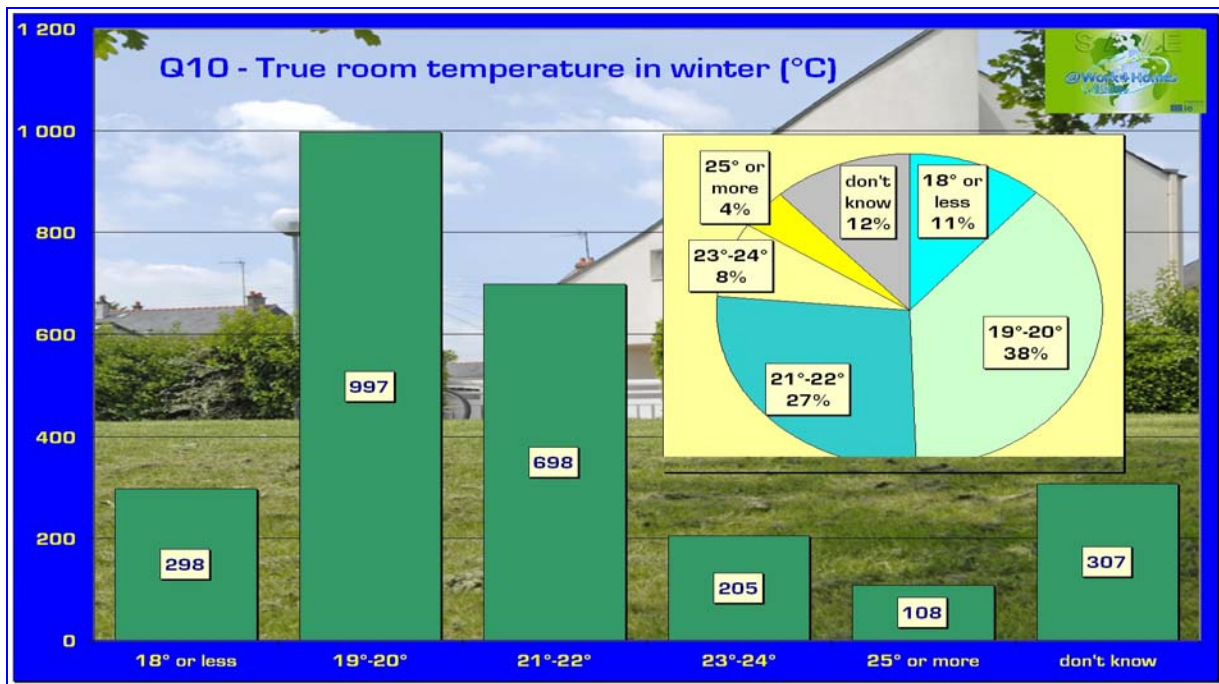
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<sup>1</sup> The tenant survey has been made during the first months of the project (March-April 2007). Since this period, the rate of tenants connected to Internet has probably increased of some percentage points and the high increase of the energy prices has probably reinforced the willingness of the tenants to enhance their behaviour

### Energy saving potential

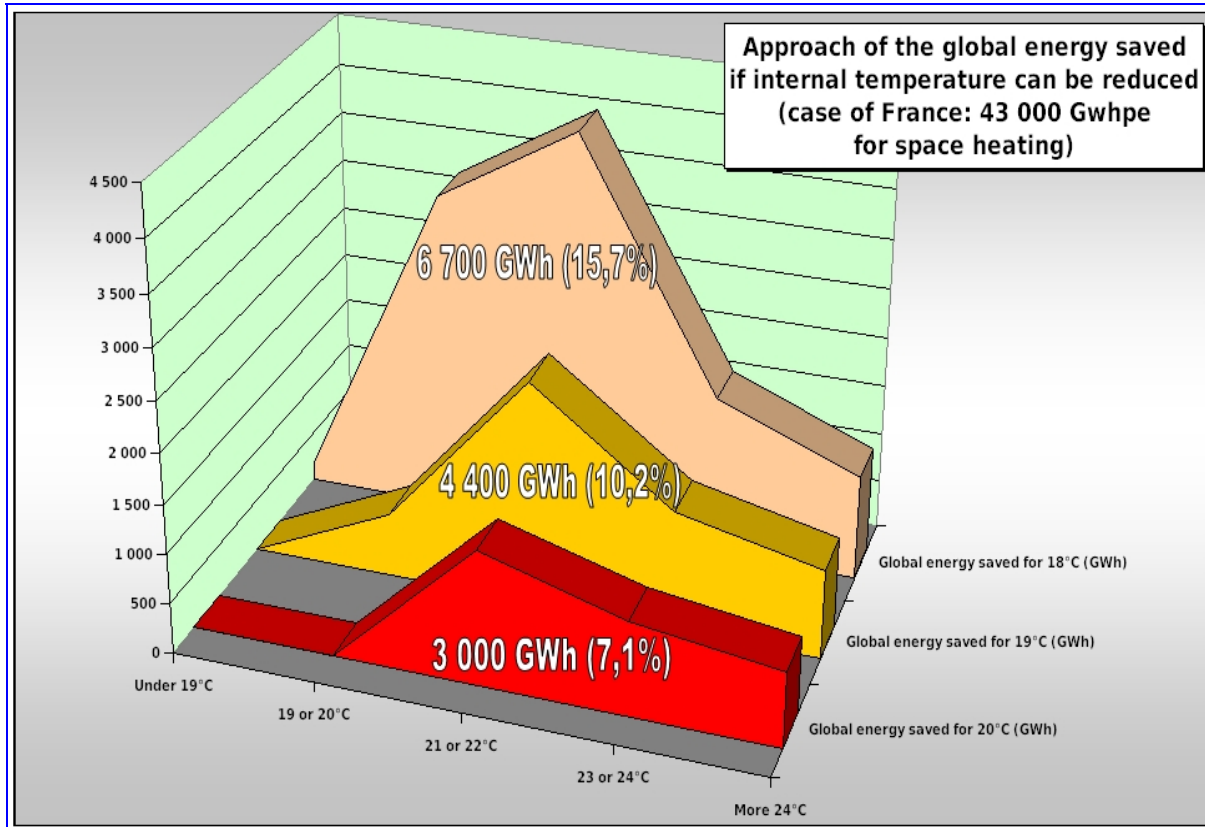
The results of the preliminary investigation conducted under this project with 2,613 tenants, had shown that a high proportion of residents overheat their housing: 27% are heated to 21°C - 22°C, 8% were heated to 23°C-24°C, 4% were heated to 25°C. The temperature recommended in social housing is 20°C. We know also that the savings generated by a decrease of 1°C of heating is about from 6 to 7%.

**Figure 1: Temperature distribution in dwellings in winter**



As an example, if all temperatures above 20°C were reduced to 20°C and by weighting with the corresponding percentage of tenants, we can calculate that a potential saving of around 7.1% can be obtained on the stock investigated. Other examples are presented below for a goal of 19°C (10.2% saved) and a goal of 18°C (15.7% saved).

**Figure 2: Approach of the global energy saved if internal temperature could be reduced**



These significant savings have to be adjusted according to the type of tenants. Many older people are found to prefer temperatures well above 20°C.

## **2. ENERGY AWARENESS SERVICES FOR EUROPEAN TENANTS**

### **Overview**

The principle Energy Awareness Services developed and introduced centred on presentation, on new Tenant Energy Portals, of consumption data for a range of energy types, and a question-and-answer-based service to improve understanding of energy saving options, the Self-assessment Tool SAT, which was also made available online.

To support feedback on energy and other natural resource consumption, automatic monitoring of consumption data was introduced, also in respect of heating costs. Heating data were adjusted to weather conditions and all consumption data given appropriate units and graphical form for presentation to tenants via the Tenant Energy Portals or other methods.

The Self-Assessment Tool was developed to help residents understand the behavioural parameters affecting their energy consumption. The self-assessment tool can be used independently of the availability of consumption data. Both self-assessment tool and consumption data feedback were provided to tenants on newly constructed internet portals - tenant energy portals. Tenants were assisted in obtaining internet access with the use of low-cost WebTV and new power-line networks. Delivery was also through notebook computers taken to residents by property managers.

Given the variety of living conditions and regulatory environments in European social housing, a single service for feedback on energy and other resource consumption cannot be expected to meet all needs. Instead, the project partners developed a complementary set of Energy Awareness Services, based on a common toolbox of components.

### **Self-Assessment Tool**

The self assessment tool (SAT) designed in the project is easy to use and manage. When the user accesses the tool on at a tenant energy portal or other web-site, a welcome screen is shown and the user is able to proceed to start answering the questions. One questionnaire within SAT shows a set of questions and possible answers for the user to choose. After each answer, the user is also given an explanation of the answer they provided and of the correct answer.

From the management point of view the application allows the manager to define as many questionnaires/surveys as needed (the number is not limited). Each of them may consist of many questions (number is also not limited). For each question it is possible to define many answers and one explanation text (description of answers). The application is managed through the web graphic interface (web GUI) – accessible by a web browser.

A PDA-based version of this SAT has been specifically developed to be used it on a PDA by the social housing staff when the tenants have no Internet access.

## Tenant Energy Portal

Feedback to tenants on their energy behaviour was provided in SAVE@Work4Homes through tenant internet portals which allow the provision of both public and personal information to tenants:

- provision of personal consumption information,
- provision of a benchmarking of the consumption,
- hosting of the self assessment tool,
- provision of general information about behavioural impact (advice downloadable brochures),
- provision of personalised information (messages from social housing staff, contractual data of the tenant).

Unlike other means of communication the portal can provide consumption data in “near real time”.

Different techniques were used to present the data, from graphs over 12 month periods to monthly consumption values in kWh.

Values in Euro have not been used to date for heating, as housing providers are concerned that legal liabilities may arise from inevitable discrepancies between the monthly measures compared to those used to generate annual invoices. Work is planned to correct these divergences and incorporate them into a monthly or daily calculation regime.

Feedback on energy consumption can come in multiple forms, and as yet there is little systematic knowledge about the effectiveness of particular ways of presenting the various comparisons which can be made. In SAVE@Work4Homes three types of feedback were offered:

- Historic feedback – comparison of recent consumption with that in previous periods
- Comparative feedback – relative consumption compared with other residents,
- Normative feedback – consumption relative to a target figure

In **Berlin**, the primary focus was historical comparison.

It was seen as important to avoid the confusion of influences of changes in the weather on the data, which mask impact of tenant behaviour. This was achieved by normalising heat consumption using local degree-day data.

The type of display chosen was graphical, showing both the normalised (predicted on the basis of previous behaviour) and non-normalised data.

Figure 3: Historic (monthly) feedback on heating energy consumption (Berlin)



In **Frankfurt**, primarily historic feedback is also used. Consumption of heating energy is displayed on a monthly basis and comparison made directly with previous months.

The normalisation of heating data by local weather information was also applied. For an easy understanding by the tenant, a synthesis of the results are presented in a traffic-light display, showing month by month whether the tenant had improved energy consumption through behavioural change - or not.

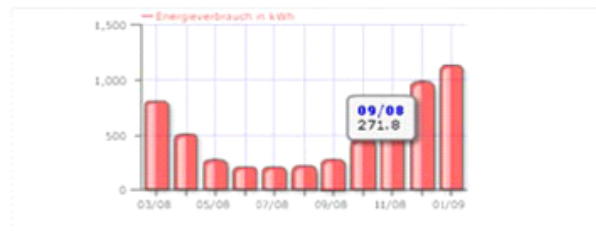
Figure 4: Historic (monthly) feedback, traffic light presentation, heating energy (Frankfurt)

Übersicht über Ihren Energieverbrauch

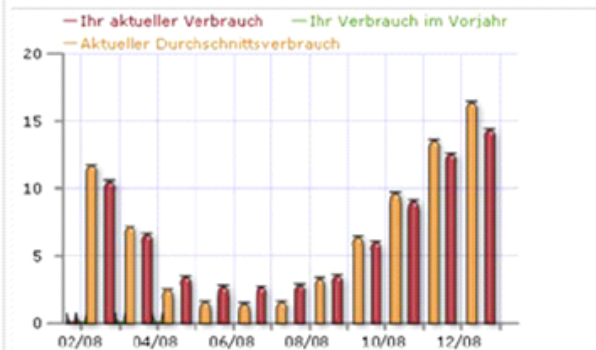
Die folgenden Informationen sollen Ihnen helfen Veränderungen im Energieverbrauch zu erkennen um entsprechend handeln zu können.



Die Verbrauchsampele Ihrer Wohnung für Januar  
 Sie haben im Januar etwa gleich sparsam geheizt wie im Dezember



Monat	Verbrauch	Zählerstand	
01/2009	1131,10 kWh	21519,60 kWh	●
12/2008	987,20 kWh	20388,50 kWh	●
11/2008	712,60 kWh	19401,30 kWh	●
10/2008	469,90 kWh	18688,70 kWh	●
09/2008	271,80 kWh	18218,80 kWh	●
08/2008	214,50 kWh	17947,00 kWh	●
07/2008	203,50 kWh	17732,50 kWh	●
06/2008	206,00 kWh	17529,00 kWh	●
05/2008	266,00 kWh	17323,00 kWh	●
04/2008	513,60 kWh	17057,00 kWh	●
03/2008	821,50 kWh	16543,40 kWh	●



The Frankfurt portal also displays data from the rental contract - rent with its components, the area of the dwelling - and contact persons at the social housing company. Information around saving energy, tenants magazine can be downloaded and links provided to the official website of the social housing company.

In **Angers**, the focus is on relative consumption compared with other residents. Tenants can define monthly consumption limits and are warned when the current consumption exceeds the limit values. The tenant energy portal for Angers includes the following the service “Me comparer” - “Compare myself” and in addition:

- “Aujourd’hui”: Today (dashboard with a synthetic and coloured presentation of the results of the tenant behaviour and the last messages sent by the social housing staff),
- “Mes consommations”: My consumptions (display of the consumptions),
- “Mon confort”: My comfort (display of the temperatures)
- “Mon compte”: “My account” (General information on the tenant and the dwelling with targets of consumptions planned by the tenant, link to the Energy Performance Certificate of the related dwelling).

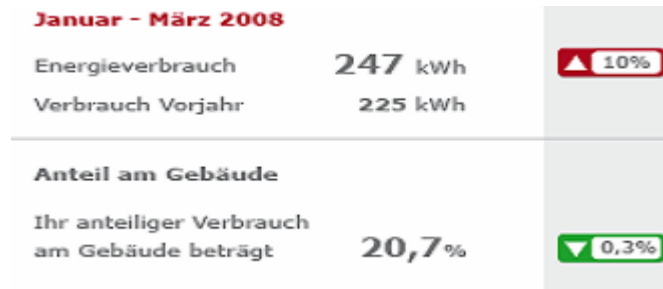
**Figure 5: Comparative feedback - tenants in the same building - electricity (Angers)**



Tenants can access the portal with a login and a password through a link in the website [www.letoitangevin.com](http://www.letoitangevin.com). On the website further information is given on energy savings including advice on energy awareness behaviours; information on waste treatment and a specific page on energy consumption. Tenants receive not only have information on their individual consumption, but also know about the energy performance of the buildings.

The Tenant Energy Portal for tenants in Karlsruhe provides multiple types of feedback, primarily historic (annual) and comparative feedback. Consumption changes are shown in percentages and given traffic-light colours for ease of assessment.

**Figure 6: Historic (annual) and comparative feedback - heating energy (Karlsruhe)**



In **Moulins**, tenants are shown their consumption relative to a target figure, thresholds defined by the tenants themselves (normative feedback), and comparative feedback based on the consumption data of various reference groups (e.g. comparisons with the average consumption of the settlement or the tenement, comparisons with households of the same size).

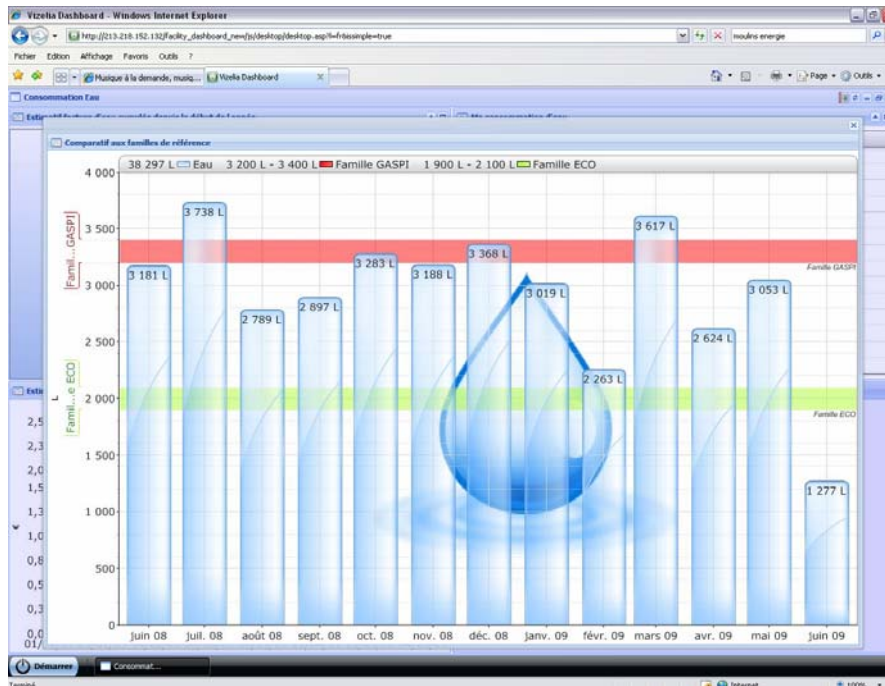
The tenant energy portal at Moulins Habitat includes the following services:

- display and benchmark of consumptions (water, energy),
- temperatures display (internal, external),
- general advices on behaviour change.

**Figure 7: Normative feedback with threshold (norm) set by tenant - Gas/Electricity/CO<sub>2</sub> (Moulins)**



Figure 8: Consumption display and benchmark



### 3. THE PILOT SITES

#### Angers

Le Toit Angevin (LTA) is a social housing company with a housing stock of 7,000 dwellings which are located mainly (92%) in the town of Angers and its close surroundings.



ENTREPRISE SOCIALE POUR L'HABITAT

- 80% of LTA stock is flats including low, medium and high-rise blocks and some 20% of dwellings are individual houses.
- 44% of LTA dwellings have a community heating system, which is centrally managed by LTA on behalf of tenants. Tenants pay monthly heating charges along with their rent and LTA pays the heating bills to the supplier. Estimates of monthly heating charges are updated each year depending on the energy prices and tenants individual consumption.
- The other 56% have individual heating systems for which tenants are responsible for paying their bills to the supplier directly.

LTA has developed a large program of refurbishment of its housing stock that aims to reinforce building insulation and install equipment to decrease energy and water consumptions.

New European and national regulations relating to energy in housing have also been applied to new buildings. Certifications such as (Very) High Energy Efficient Performance or Passive House are applied for.

These developments on energy savings are a new field of intervention for Le Toit Angevin and their partners (architects, suppliers, technicians...) and each operation of refurbishment and construction, improves the knowledge in these matters.

There is a necessity to balance on the one hand, the additional costs incurred by the new equipment and the new methods used for constructions and on the other hand, the expected energy savings. This balance depends not only on the characteristics of the dwellings but also on the behaviour of their occupants.

For this reason, it is obvious that the efforts made on the building structures and its equipment must be supported by a communication plan with tenants to make them aware of the energy consumption of their own dwelling.

Today all citizens receive general information on sustainable development and on the necessity to decrease energy consumptions as well as the reduction of waste and pollutants. But not many people have accurate information on the level of their own energy consumption compared to the average energy consumption, except maybe through their bills (for individual heating systems) or their heating charges (for community heating systems). However, bills and heating charge receipts are not always suitable for providing relevant information to make people change their behaviour.

With the project developed in the suburb of La Roseraie, which represents about 600 recently refurbished dwellings, new methods of communication with tenants

regarding energy savings were tested. These new methods consist of getting information on electricity and water consumption, as well as information on the temperature in the dwellings, directly from the meters and transposing the data onto a portal.

## Belfast

The North Ireland Housing Executive (NIHE) is the major social housing landlord in Northern Ireland with a housing stock of 93,000 dwellings. The breakdown of the housing stock is as follows:



House Type	No.	%
Bungalows	20,774	22.2%
Terraced houses	46,808	50.1%
Semi-detached houses	7,180	7.7%
Flats/Apartments	18,664	20.0%

As can be seen above, 80% of NIHE stock is single or two-storey individual houses and all with individual gas, oil or coal fired heating systems,. Some 20% of dwellings are flats including low, medium and high-rise blocks but all have individual gas, oil or electric heating systems. None of the NIHE stock including the flats has a community or district heating system or any system that is centrally managed on behalf of tenants. All NIHE tenants are responsible for paying their heating and electricity bills to the supplier directly - the landlord has no role in this. The landlord's role is simply to provide the heating or electricity system, repair and maintain it, but takes no role in billing or metering.

With nearly 75% of Northern Ireland's households owning their own home, the tenants of the NIHE tend to be households who cannot afford home ownership. All NIHE tenants tend to have low incomes with around 80% of NIHE tenants living on some form of social welfare benefits. The stock is generally well insulated with high efficiency boilers for heating with 35% of tenants using oil, 25% using natural gas, 20% coal and 13% using electricity for heating.

Due to the context for social housing and energy services in the UK, the Housing Executive cannot use the methods being utilised by the German and French partners in this scheme. The internet portal services offered in France and Germany were inappropriate for Belfast given the extremely low level of internet access among NIHE tenants and the fact that the energy utilities cannot share energy consumption data with landlords.

In this project, therefore, NIHE focused on three issues.

The first was the general survey carried out by the other partners on tenants attitudes to energy efficiency and the environment.

The second was establishing, through a survey, how effectively tenants were using their heating controls and providing more in-depth face-to-face advice to the 38 tenants who said they did not understand how to use them properly.

The third element was introducing new technology to bring advice to tenants through using Personal Digital Assessors (PDAs) to let tenants use the Self Assessment Tool as only a tiny minority of them has internet access.

## Berlin

STADT UND LAND (SuL) is a German housing company based in Berlin. The company manages about 47,000 buildings with 590 employees. Since 1924 STADT UND LAND is owned by the state of Berlin (100%). Social responsibility is the company's watchword. Its declared aim is to provide affordable housing for a wide spectrum of the population.



STADT UND LAND has ambitious goals concerning environmental protection. In 2005 the company got to be the first state-owned housing company in Germany and the fifth European housing company to be registered in the EMAS-Register (Eco-Management and Audit Scheme). The participation of STADT AND LAND in the project SAVE@Work4Homes was the consequent continuation of the environmental policy of the company.

As a pilot site STADT UND LAND chose two buildings with about 102 dwellings which are equipped with radio metering devices. Thus it is possible to collect the consumption data without entering the tenant's flat, which is a necessary precondition for the services offered in this project. Having the tenants with the highest average age among the partners of this project, STADT UND LAND chose two different approaches of how to deliver the information on the energy consumption. Thus additional to the internet portal which is part of most partner's services the company also informs its tenants by mail – condensing the complex data on one single sheet of paper.

## Frankfurt

Nassauische Heimstätte Wohnungs- und Entwicklungsgesellschaft mbH (NH) is the leading member of the company group "Nassauische Heimstätte/ Wohnstadt" the largest supplier of rented housing accommodation in Frankfurt am Main and the state of Hessen, with approximately 64,000 housing units in more than 160 cities and communities.



Nassauische Heimstätte business aims have shifted in recent years from the traditional emphasis on real-estate and buildings to focus directly on the needs of people living in their accommodation. By creating a high quality of social living environment, the company is on their way to radically improve the overall quality of their service to tenant customers.

Nassauische Heimstätte targets energy awareness services based on in-building consumption monitoring. The services comprise general tenant information to help identify possible changes in tenant behaviour to save energy without unwanted side effects. The sites trials took place in three pilot sites in Stadtallendorf and Bad Hersfeld with approximately 300 housing units. All dwellings are equipped with radio controlled meters and the consumption data are transferred monthly to the internal IT systems. There the annual billing will be done by the subsidiary MET (Medien, Energie und Technik) which is also provider of the heating systems.

## Karlsruhe



Volkswohnung (VoWo) was founded in 1922 and is today – as the city-owned privately organised municipal housing company - the largest housing company of the City of Karlsruhe. Volkswohnung is today operating 690 multi-family buildings with 12,300 flats, most of them within Karlsruhe. About two thirds of them have been constructed after WW II. With an average rent of about 5.00€ per m<sup>2</sup> per month, Volkswohnung's rents are well below the average rent in Karlsruhe, thus serving affordable homes to low-income tenants.

Since the end of the 1980s, a continuous refurbishment program has been implemented. About 50% of the building stock has been retrofitted so far. The average end-energy consumption for heating and domestic hot water has been reduced by this program from almost 240 kWh/m<sup>2</sup> in the 1980s to about 140 kWh/m<sup>2</sup> today. One aim of this refurbishment program is to replace existing individual heating systems by either gas or district heating central stations for every building. Over 80% of the buildings are operated with central heating today, about 10% are using individual gas boilers within the flats and less than 5% are still operated with other individual heating systems (oil or coal ovens for heating and electric domestic hot water preparation).

Since 2003, as a part of the refurbishment program, flats with central heating systems are being equipped with wireless radiator sensors which register the heat supplied to the heated rooms, and heat meters for domestic hot water in bathrooms and kitchens. Almost 80 % of Volkswohnung's dwellings are today operated with these devices, with an investment of about € 3 Mill. so far. Information transfer reliability problems with the first generation of these devices caused a continuous replacement program during regular calibration periods by new devices, which is still ongoing. Due to the increased reliability, the data logged by these devices can now be read monthly instead of yearly, which gives the opportunity to gain a monthly heating energy balance and domestic hot water consumption for each flat, as a basis of a future energy awareness service for the tenants.

Volkswohnung's motivation is to reduce energy costs for their tenants both by building refurbishment and by enabling the tenants to save energy without reducing comfort as part of a long-term sustainability strategy. The aim is to achieve a maximum of energy conservation by a minimum of expenditure.

## Moulins



Moulins Habitat (Moulins), social housing company of the City of Moulins (Allier - 03), manages an estate of about 4,000 flats distributed around Moulins' conglomeration.

Moulins Habitat joined for several years in a process of reduction of the energy consumptions and thus maintenance costs for its stock. It sought to convince the tenants, the final consumers of the energy and the water, and the main beneficiaries of the possible gains and the savings. In this frame, Moulins Habitat participated in SAVE@Work4Homes. This project joins in a wider process of refurbishment of about 2,000 flats within the framework of the Project of Urban

Renovation on the districts of Moulins-Sud and Yzeure-Le Plessis. Within the framework of this project, Moulins Habitat emphasised the sustainable development by favouring a reduction policy for energy and education of its tenants.

In this context, the south districts of Moulins were thus appointed as main pilot site to achieve this project:

- Champins (242 apartments);
- Îlot Thonier (229 apartments);
- Champmilan (555 apartments);
- Nomazy (574 apartments).

Besides, Moulins Habitat also decided to widen its field of experiment to one hundred dwellings in city centre where individual gas heating is used contrary to the flats of Moulins-Sud which are served by the communal heating system. Similarly, Moulins Habitat also equipped its head office to educate the entire staff who, in turn, can then contribute to the education of the tenants.

The objective of Moulins Habitat is to equip its whole housing stock to gather data on water and energy for the benefit of its tenants but also with the aim of being equipped with a real tool of supervision, with management and with evaluation.

Indeed, these last years Moulins Habitat has worked hard on the energy rehabilitation of its housing stock and to construct buildings with very high energy performance to address increased energy costs and the decline of the purchasing power of his tenants. In this context, the objective also was to be equipped with a tool to estimate the efficiency of the rehabilitations made as well as the performance of the various types of construction.

The current project is translated by 3 actions to the tenants:

- A communication strategy to the tenants which outlines:
  - The organisation of meetings to debate the subject of sustainable development with both children and adults.
  - The development of an interactive document explaining the stakes the sustainable development and available on the company's Internet site.
- The display of data of consumption of energy of the dwelling via an internet access, with tools for the comparison with consumption of a standard flat.
- The implementation of an interactive system connecting the tenant and the landlord leading to energy savings, to reduce possible excessive and, where necessary, outline corrective action.

## 4. INTRODUCING ENERGY AWARENESS SERVICES - REQUIREMENTS

### Overview

The information in this and the following two sections has the primary purpose of supplementing the report with key information for social housing providers in France, Germany, the UK and in other European regions who are interested in introducing Energy Awareness Services into their housing stock. Information is therefore provided on technical **requirements** e.g. for internet access or data collection, on **costs** - both for service provision and infrastructure - and on relevant legislation and **regulation**.

This section reports on results relating to requirements for internet access and data collection infrastructures - for collective heating, individual heating, water and household electricity.

### Requirements for Internet access

For many of the services offered in the SAVE@Work4Homes project, the tenants must access the Internet. Access to the Internet is not only necessary for the project's services, it is also a means to access energy information provided by the social housing company and many other actors at a European, national, regional and local level.

Numerous energy information campaigns and advice provided via the Internet can certainly permit tenants to enhance their behaviour. These range from projects (e.g. SERENADE <http://www.energy-advice.org/>) to the websites of the energy agencies (ADEME etc.) and energy providers (EDF, EON etc.).

### Provision of home access

In the project's Energy Awareness Services delivered by Tenant Energy Portal, consumption data is collected and processed, enabling tenants to access the details via the portal with individual login and password. Clearly, tenants without internet access cannot use this service in this way.

Internet access depends on access networks and services often provided by telecommunications service providers. Several social housing providers wish to accelerate penetration of the Internet among tenants - both Moulins Habitat and Le Toit Angevin do so as part of their fight against the digital divide.

Providing an access network is, however, not sufficient. The tenants have also to be equipped with PC or others tools. In this context, social housing companies may, like LTA, choose to provide some of its tenants with new or recycled computers or work with a social enterprise company to provide them.

In Moulins, an access network was implemented in a previous project. A terminal had also been provided free of charge to the tenants by Moulins Habitat. This Netbox was connected to the Web-TV network and used the TV set as display screen. However, tests early in the project showed that the Netbox was not well-suited to accessing the Energy Awareness Services being designed.

Modernization of the access network was being planned alongside implementation of a PLC infrastructure. During this, continued use of the network Web-TV is possible thanks a modem provided by Moulins Habitat. Moulins Habitat also undertakes to give some tenants PC access. Work is ongoing at the time of writing to implement a company of social insertion to create a field of recycling of computers in order to be able to offer tenants cheap computers.

### **Provision of public access points**

A public access point is a room equipped by a local authority or a social housing to permit a collective access to Internet. Some social housing in the project have developed their own public access point to facilitate the training of their tenants in the use of the.

For tenants without internet access, Moulins Habitat installed a computer in the local office, with free access to the Moulins Habitat website and to the Energy Awareness Services on the Tenant Energy Portal. The access point provided by the city, also managed by Moulins Habitat, is also available for tenants.

### **Paper-based communication**

Paper-based communication is another option for reaching tenants without internet access. Paper is also suited for tenants who are not online because they reject using modern communication technology at all, rather than simply lacking the equipment or service. An attitude of rejection can be found among older people and those with a lower level of education – both likely to live in social housing.

Paper-based communication was provided not as an alternative to the Tenant Energy Portal but an additional service to reach even more tenants. The service is technically based on the same software environment that feeds the internet portal - uses the same database, the same benchmark algorithms and the same presentation techniques.

When STADT UND LAND decided to publish an information letter, it was realised that this could not contain the same level of detail as an internet portal. The content needed to be condensed on one page. STADT UND LAND chose the following aspects:

- a table of the heating consumption by heating device for the last six months,
- a benchmark graphic for the last two years,
- a table of the water consumption for the last six months.

STADT UND LAND publish the information letter once a month – the same frequency in which the data on the internet portal is updated.

The service is easy to operate. When logged on to the STADT UND LAND tenant portal as “Administrator” you can choose the menu item “Print Out”. Here you decide for which tenants you want to print the information letter. The result is an internet page which can be printed directly with the “Print”-function of the browser. Simple layout settings like margins can be changed via the print settings of the browser. More complicated layout changes have to be programmed - but this is as simple as changing the layout of a page in the tenant portal.

Figure 9: Information letter at Stadt und Land



**PDA-based services**

In Belfast, due to the low level of internet access among Northern Ireland Housing Executive tenants, the Housing Executive sought alternative ways of using new technology to bring advice to tenants. One method was through using Personal Digital Assistants (PDAs) to let tenants use the Self Assessment Tool. Three Neighbourhood Wardens brought this service to around 160 tenants over a three 3 month period. This was as part of a pilot exercise by the Housing Executive on the use of PDAs generally by Neighbourhood Wardens. The pilot exercise has now been completed. Whilst the use of PDAs was successful in bringing energy advice to tenants, some security issues were identified with the use of this technology.

**Requirements for measuring consumption information**

**Measuring consumption information**

Many of the project's Energy Awareness Services are based on the collection of consumption data. To provide this data a network of sensors has to be used or built and their data has to be collected automatically.

**In the German case**, the network of data collection already exists in many cases. The work is only to interface the existing network to a communication network for transmitting the data to the information system used to treat and present the data to the tenants. In some cases the data collection equipment may be too old and does not fit the system (evaporators for example) and must be replaced.

**In the French case**, for heating system, the data collection requires the construction of a new network. The sensors are thus placed on meters and record the state of consumption every hour before transmitting the data to a module switching hub. The switching hub then sends, once a day, consumption or temperature data to a server, in which the data are processed. The communication network used is the mobile network, via a GPRS line in Moulins and a power-line communication (PLC) network in Angers. For water, gas and electricity, the data collection requires the replacement of number of meters incompatible with the chosen technology. Meters must be electronic and provide electronic pulses to communicate with the service software.

**In the United Kingdom case**, heating is often not managed by the landlord. Data collection is then not possible by the housing company for legal reasons.

### **Measuring space heating consumption**

Heating consumption can be measured by different methods depending of the modalities of the distribution of heating. In the case of individual heating, the metering is provided by the energy provider and billing is by the energy provider directly to the tenant. In such cases the social housing provider generally does not have access to consumption information. There are different means for metering collective heating:

A calibrated energy meter can be used, if the distribution network is appropriate - horizontal loop inside the flat distributed from one point. In France, very few distribution networks built before the first oil crisis are organised in that way. In France, this system was introduced after the first oil crisis and continued later with the CIC system promoted by energy provider Gaz de France. However, this topology today represents under: 1% of the social housing dwellings. Individual heating systems have been preferred and are being installed in the vast majority of new buildings. In contrast in Germany, network topology is often suited to introduction of calibrated energy meters (calorimeters).

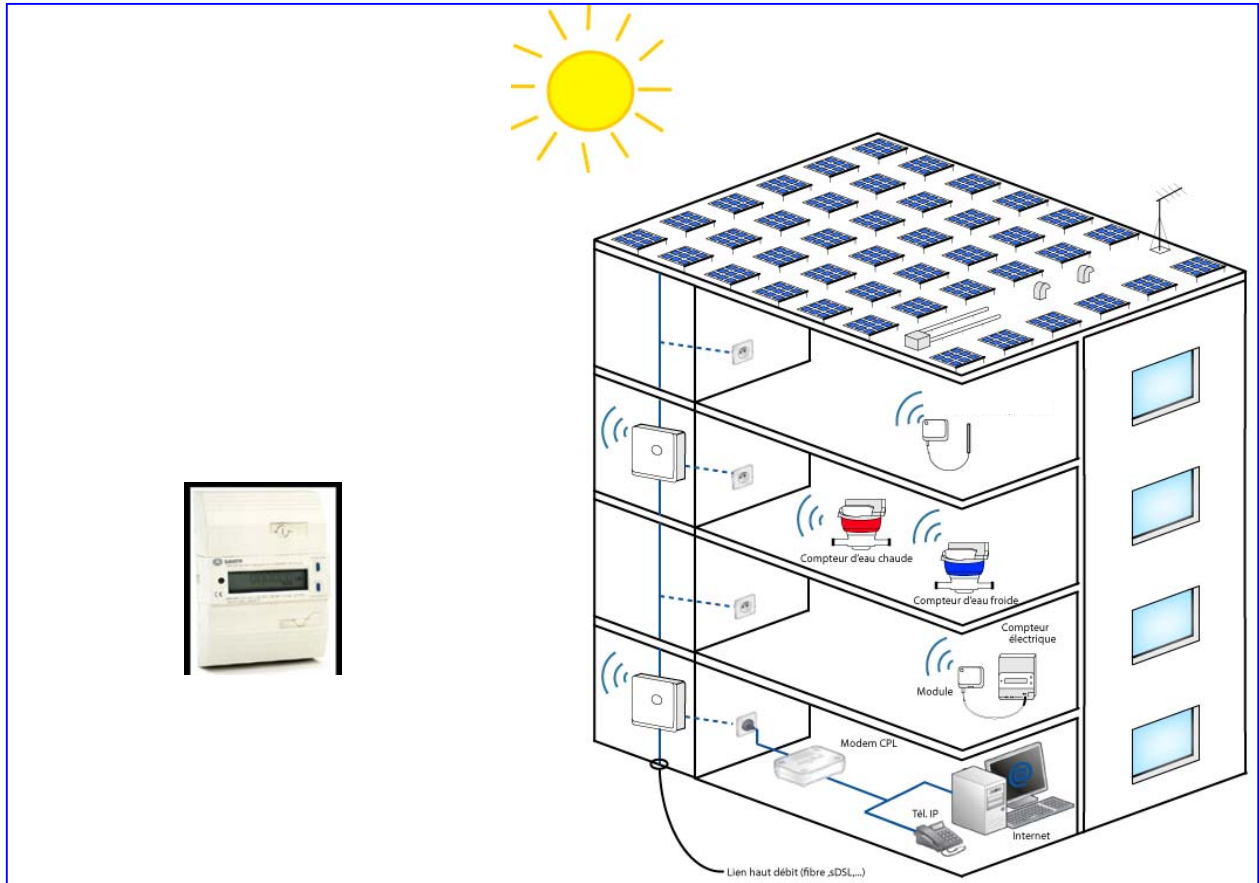
When distribution network is organized vertically, such that the same pipe goes through all the flats from the ground to the top floor of the building, the only widespread solution is to measure radiator emission. Here devices are deployed which measure the heat lost by individual radiators, using proprietary techniques and units. The first generation of these heat "cost allocators" were based on the evaporation of a liquid and cannot be used in automatic collection. The newer electronic generation can be equipped with a radio-emitter or line-emitter. In Germany, and in general, in the Nordic countries, this system has been used for many years, but, in middle and south of Europe countries, like France, this system has hardly been used anywhere outside the Alsace region.

Calibrated energy meters (calorimeters) and radiator heat meters for heat cost allocation have been primarily introduced to support consumption-oriented billing of tenants, so that bills reflect the energy consumed. Thermometer information used in the project does not have this function. It is not planned to bill the tenants using the information, but to detect the good working of the heating system and give feedback on the behaviour of the tenants. Though there is no impact on bills, the accurate information is provided to tenants to help them to enhance behaviour if they think that it is good for him or for planet. In addition, the operator of the heating system enhances system monitoring.

## Infrastructure for collective heating systems

Specific information on infrastructure for collective heating systems is provided from Angers and Moulins.

**Figure 10: Measurement infrastructure for collective heating housing**



In **Angers**, in order to make the Energy Awareness Services possible for the tenants, an infrastructure had to be implemented. The device developed is composed of the following equipment:

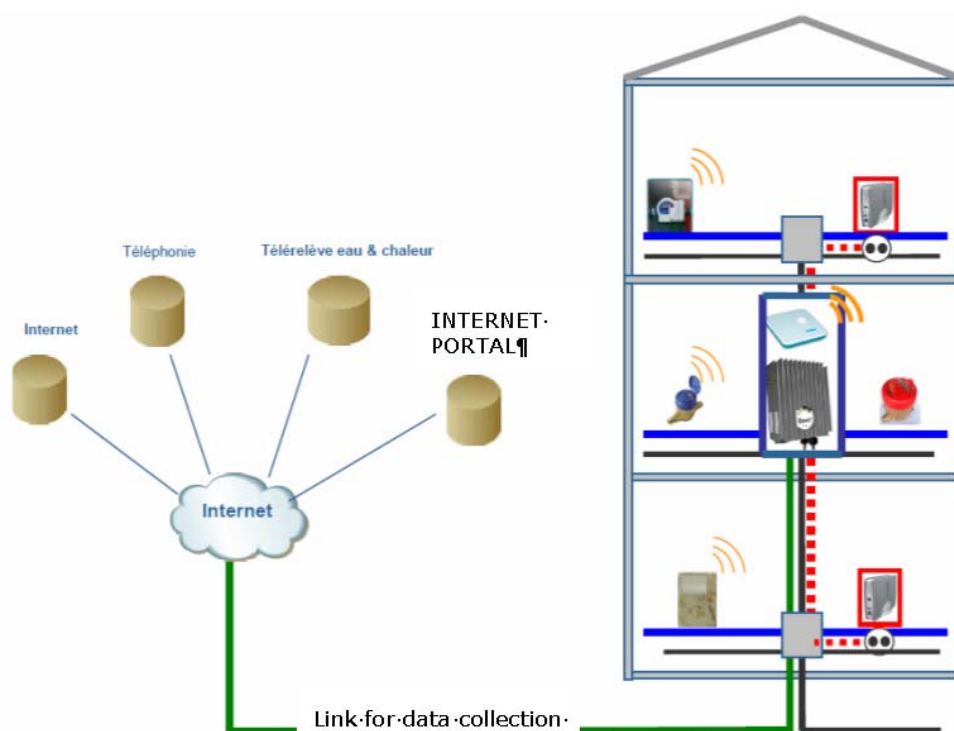
- An optical fibre linked to the 12 buildings of the site: This fibre is connected to a Power Line Communication (PLC) infrastructure located in the rising main, it is also equipped with an injector,
- In each flat a temperature's sensor is fixed in the living-room far away from the windows.

As presented in the next diagram, the data path is the following:

- the ambient temperature from the thermometer is transmitted by radio waves to the gateway located into the PLC injector, (same principle for the water and electricity with specific sensors put on the meters),
- The data are transmitted via PLC to the selector switch (links the PLC to the optical fibre),

The optical fibre connected to the Internet network transmits the data's information to the tenants and landlord portal.

Figure 11: Data collection at Angers



This technical choice is justified by the specifics of the site. La Roseraie is characterized by district heating system (reprocessing). The warmth is collectively distributed by a floor heating system. Consequently, there is no other way of having a control of each flat's consumption but to use the real temperature.

In other respects, concerning the rising main infrastructure, it is important to realise that the PLC infrastructure could have been replaced by Coaxial. Indeed, LTA have had the choice either to put a PLC infrastructure or to do up the coaxial network. The PLC choice was made for two main reasons:

- in order to allow market forces to operate for the internet operator with different devices (coaxial and PLC)
- because LTA believed in the future development of many technologies by PLC in order to help landlord maintaining its buildings (video-entry phone, following of service providers, regulating collective heating, medical supervision, video surveillance, ...).

Today, the cost of the PLC infrastructure and its maintenance cost, added to the development of the optical fibre technical functions, lead LTA to prefer other options than PLC.

Collective heating infrastructure was also introduced in **Moulins**. The south districts of Moulins (Les Champins, Îlot Thonier, Champmilan and Nomazy) were provided with these services. For the first testing step, the service is operational for 71 dwellings. These flats are using collective heating (network of heat, district heating system and collective boilers).

The proposed service is based on:

- a communication network by waves radio;
- a temperature sensor placed in each flat;
- a data collection every hour (collected data sent to a switching hub which send, once a day, the data to a server in whom the data will be processed)

### Infrastructure for individual heating systems

Specific information on infrastructure for individual heating systems is available from the Moulins and Belfast pilots.

Dwellings located in down-town **Moulins** are equipped with an individual heating system with gas. Moulins Habitat had planned to connect some sensors with the gas meters. But after one year of negotiation, agreement of GRDF and GDF (French gas provider) was not reached. Moulins Habitat installed new meters after the GDF meters to be able to collect the data consumption of gas.

The data of gas consumption are not sufficient to evaluate the behaviour of the tenant and is used with the internal temperature measured in each dwelling.

NB: The gas is not only used for the individual heating system but also for cooking.

In Northern Ireland Housing Executive homes in **Belfast**, the infrastructure or meters to measure energy consumption are provided by the energy suppliers. The Housing Executive, however, provides room thermostats, cylinder thermostats and programmers to allow tenants to manage or regulate their consumption. However, the Housing Executive cannot help them to do this through a tenant portal as the Housing Executive does not receive consumption data from suppliers and there is a low level of internet access by tenants. However, the Housing Executive provided general advice to tenants through the use of the Self Assessment Tool via PDA's.

### Infrastructure for water usage

Specific information on these services is available from the Angers and Moulins pilots.

In **Angers**, with the same transmission device for the data as the one used for temperature (radio waves, PLC, Optical fibre), LTA collects the water consumption's data in real time thanks to the replacement of the hot water and cold water meters. Previous meters were not capable of automatic data transmission. The new meters require the addition of a sensor to ensure the data are collected and transmitted by radio waves. In order to get the energy awareness service, there was no other solution than to get this new equipment.

In the case of **Moulins**, the existing water meter was changed to new ones equipped with a pulse emitter. The system depends on sensors' network assuring the telemetry of all the data relative to the consumptions of water communicating by electronic pulses and radio waves.

The data collection thus requires the construction of a real communication network by radio waves. The sensors are thus placed on counters and record the state of the consumptions every hour before transmitting the data so collected to a module-switching hub. The switching hub sends then, once a day, the data of

consumption or temperature to a server, in which the data will be processed, via a line GPRS.

### **Infrastructure for household electricity**

Specific information on these services is available from the Angers and Moulins pilots.

To obtain the data on electricity easily, meters in **Angers** have been replaced to be compatible with sensors to receive the data. At the same time, a set of components based on a PLC infrastructure has been installed in the building and linked to the local network so that information can be transferred to the housing company as often as necessary and without any necessary human intervention in the building.

The system deployed by **Moulins** Habitat depends on a sensor network ensuring the telemetry of all the data relative to the consumption of energy communicating by electronic pulses and radio waves. The data collection thus requires the construction of a real communication network by radio waves. The sensors are thus placed on counters and record the state of the consumptions every hour before transmitting the data so collected to a module switching hub. The switching hub sends then, once a day, the data of consumption or temperature to a server, in whom the data will be processed, via a line GPRS. This mode of collection requires the replacement of certain number of incompatible meters with the organized technology. Indeed, meters must be electronic and be endowed with electronic pulses to communicate with the set up sensors.

As regards the partnership with EDF, within the framework of a blanket agreement linked to the program of current rehabilitation, it concerns mainly the replacement of all the meters in place. Indeed, these last ones date back to the 1970s and are thus incompatible with the technology organized within the framework of this project. This technical support should then cause no additional cost as far as the replacement of these meters returns within the framework of a blanket agreement of partnership between EDF and Moulins Habitat.

### **Construction and introduction of the Self-assessment Tool SAT**

The implementation of SAT takes about 1 day and consists of:

- preparation of the web server platform (Apache/IIS with PHP, MySQL)
- installation of the CMS and the SAT module
- configuration of the managers of the module
- questions/answers preparation
- configuration of a specific survey to be shown on a specific page of the website.

Managers of SAT need training on using it. The training takes about 3 hours.

The self-assessment tool is built using the web application language PHP and can be run on wide-spread web server platforms (Apache, IIS). SAT works as a plug-in to a CMS (web content management system) solution, so it is very easy to

prepare a whole website explaining the meaning of the tool and deliver more content to users.

It can be also implemented as a module within existing website (not necessarily using the above mentioned CMS solution) and the only requirements for the environment are: PHP 5.x (or newer) and MySQL database 4.1.x or newer.

## 5. INTRODUCING ENERGY AWARENESS SERVICES - COSTS

### Overview

The information in this section is intended to support decisions by social housing providers in France, Germany, the UK and in other European regions who are interested in introducing Energy Awareness Services into their housing stock. Information is provided on costs - both for service provision and infrastructure.

### Costs of service provision

#### Tenant energy portal

The costs for providing a tenant energy portal are generally composed of:

- infrastructure costs to collect the consumption data
- software development costs to analyse and benchmark the consumption data and provide information to the tenants,
- subscribing costs for providing the Internet access to the tenants and, eventually, for the system of collection of data,
- tenant equipments (PC, laptop, netbook, MID, Smartphone) for using the benchmark tools,
- operating costs (including staff costs)

Generally, a decision needs to be made whether the costs of the services shall be shared between the tenants and the housing company or not.

Specific cost information is available from project work in Angers, Frankfurt, Karlsruhe and Moulin.

In **Frankfurt** it was important to determine which investment costs are new and where equipment or services already exist. Metering and billing costs are already included in the rent. So only the costs of data processing and providing the tenant portal will be additional costs. These costs depend on the number of users and will be between 5000€ and 12000€. One component is the adoption to the other IT systems where some interfaces must be created. These initial costs can be estimated at 10.000€. Nassauische Heimstätte will not charge these costs to the tenants because offering these modern technologies will reduce phone calls and other personal requests by the tenants and improve the service quality.

To add to existing consumption measurement system in **Karlsruhe** a tenant energy portal required:

- the software development necessary to evaluate the measured data to provide them with the tenants portal,
- development of portal interface and
- extra server hardware
- operating costs to operate and maintain the portal (monthly data evaluation and updating the portal's information content and keeping an

information service to react to tenants feed-back about the portal to be provided by the dwelling management department).

The total tenants portal cost structure as estimated according to the experiences so far is estimated as follows (all costs include VAT):

<b>Investment costs</b>	<b>VoWo</b>	<b>external</b>
development of data base interface:	6,500 €	12,000 €
development cost of portal interface:	4,500 €	30,000 €
extra server hardware installation:		2,000 €
Total investment costs		55,000 €
Costs by household		~ 5 € per flat

<b>Operating costs</b>	<b>VoWo</b>	<b>external</b>
operating cost for continuous server operation by external service:	4,500 €/a	2,000 €/a
man power cost of monthly portal data handling to transfer measurement data to portal system: (estimated)	3,300 €/a	
tenant service cost (hotline, FAQ etc.): (estimated)	25,000 €/a	
Total operating costs		~ 35,000 €/a
Operating costs by household		~ 2 – 3 € per year and flat

These costs will be integrated into the overhead costs for billing of heating costs, which is possible since 2009 due to a change in the heating cost ordinance. These costs have not been calculated so far. The extra costs that are caused by introduction of the tenants portal are about 3% of the total costs of the wireless heating and domestic hot water consumption measurement system.

In order to achieve a large participation, the view from **Angers** is that the costs paid by the tenants should not be too high. In Angers the tenants must pay 2.50€ per month while the housing company has costs in total of approximately 2,000€ per flat (one-off expenses: Internet equipment like optical fibre, data reading devices like sensors and meters, computers. Ongoing expenses: Maintenance and internet access). Additionally the tenants have non-monetary costs like interest, willingness, time and experiences in dealing with personal computers.

For the operating costs, the service is free of cost for the tenants.

For **Moulins**, the global financial frame of the project was the following:

Software:	10,764 € TTC
Server, sensors (*) and radio equipments:	27,843€ TTC

	(350 € by dwelling)
Hosting and maintenance (36 months):	32,390 € TTC
Costs for the Vizelia solution	71,538 € TTC.
Communication costs (**)	40 € TTC / month / line
Total cost	200 € TTC / month.

(\*) For temperature, water meters and energy meters)

(\*\*) With the 5 GPRS lines

## Print-based services

Where information is provided on paper, besides the additional programming in the development of the tenant portal, there are regular costs for printing and mailing. These can be reduced by special agreements with the postal service (which many bigger companies have anyway) or by internal delivery (e.g. neighbourhood wardens).

Experience on this was gained in **Berlin and Frankfurt**. The survey which we conducted among our tenants at the beginning of the project showed that – despite the interest in energy saving information from the housing company – only very few tenants are willing to pay for that additional information. That is why the services implemented by the social housing company are cost-free for the tenant.

The technical infrastructure – such as radio metering devices – is a precondition for the service. The service can only be offered to tenants where the technical infrastructure has been installed. In our pilot site the installation costs of the radio metering devices were divided between social housing company and the metering company. The chart below shows the planning for the future extension of the technical infrastructure.

The main costs which have to be planned are those for the running of the internet portal service and the processing of the data. In the following calculation we estimate that 13% of the tenants who have the technical option will actually use the service – like it was the case in the pilot phase (these are both users of the internet portal and receivers of the paper-based information).

DomData (Posnan, Poland) runs the internet portal. Charges depend on the number of users on top of a basic fee of 3,000€ per year. DomData currently charge 500€ per day and an average of 1 day a month can be calculated for the implementation of new data.

The working time that the social housing company has to invest in preparing the data, producing the paper version and offering a customer service for the tenant also increases by the number of users. The infrastructure is implemented for the internet portal and the paper-based information (letter) is also a function of the internet portal which is used by STADT UND LAND in order to send the information to the tenant

The figures below are a rough estimate.

Investments	Year 1	Year 2	Year 3	Year 4	Year 5
Installed infrastructure	2055 €	4055 €	6055 €	8055 €	10055 €
Estimated users (13% equipped)	267€	527€	787€	1047€	1307€
Tenant portal (DomData)	10000 €	10500 €	10500 €	11000 €	12000 €
Data processing (SUL) [200 users x 0,5 day/month]	888 €	1776 €	3552 €	4440 €	5328 €
<b>Total</b>	10888 €	12276 €	14052 €	15440 €	17328 €
<b>Cost user per year</b>	41 €	23 €	18 €	15 €	13 €

### Self-assessment Tool (SAT)

Costs of the implementation of SAT are low and the following must be taken into account when preparing the budget for it:

- cost of the web server platform – using the one already existing for a company (own or hosted, recommended) or buying a new one;
- cost of the implementation (mentioned above)
- cost of the training
- staff costs – manager of SAT (maintenance, survey preparation)
- cost of the analysis of data (see remarks below)

The above list does not include costs of delivering PCs to tenants – it is assumed that tenants are using their own PCs. In case PCs have to be delivered the appropriate costs has to be added.

Remark on “analysis of data”: The data (all surveys) is being collected in the database. SAT is not equipped with any analysis tools, so preparation of the analysis has to be done in an external tool.

The **Belfast** approach was based on PDA provision. Costs were marginal as the PDAs were provided to allow other functions to be completed. We included energy advice (via Self Assessment Tool) as part of the service provided by the Neighbourhood Wardens when they were already in tenants homes on other business. In this way costs were minimal and difficult to determine.

### Costs of data collection infrastructure

#### Collective heating systems - Germany

In Germany, collection of individual consumption data has been normal practice for many years. A German law allows housing companies to recover the costs of the data collection system and this system is widely used.

Three cases can be found:

True energy metering systems: The energy is distributed by a horizontal loop from a substation which delivers space and water heating in each flat. An electronic meter measures the whole energy in thermal kWh, but does not permit to differentiate the space and the water heating energy.

Evaporation heat meters for cost allocation systems: These systems were implemented in the first stage of the regulation application and are now substituted by electronic heat cost allocators. This old system must be replaced by the new one.

Electronic heat meters for cost allocation systems: The costs to equip a flat with wireless electronic radiator sensors are on average about 30€ per flat. Heat meters for domestic hot water cost about 60€ per device at present. Total hardware cost, including wireless data transfer systems, is about 44€ per dwelling in the average, (costs without VAT). For an average flat with 5 radiators and 1 heat meter plus 1 meter for fresh water consumption, total investment costs of about 370€ arise (VAT included). These costs are covered by heating cost service charges to be paid by the tenants to the landlord who has made the investment of about 8€ per flat and per month, which is added to the rent.

### Collective heating systems - United Kingdom

There are very few collective heating schemes in the UK and none within Northern Ireland Housing Executive stock. However, where they do exist, the cost of the meter to measure individual consumption for each household will vary depending on the sophistication of the meter and what data it is designed to provide. A very basic meter would cost around €55 whereas more sophisticated models could cost anything from €55 up to €275.

### Collective heating systems - France

Investment for reading the data automatically:	
PLC equipments for 585 flats:	115 k€ - 196 € / flat
[With another solution that uses the coaxial, cost would have been]	[29 k€ - 50 € / flat ]
Installation of 86 sensors (temperature, water):	7 k€ - 81 € / flat
Total of investment costs:	122 k€ - 277 € / flat
Operating cost for maintenance	
Maintenance of the PLC Infrastructure for 2 years:	10 k€ - 17 € / flat
Maintenance of the all sensors for 2 years:	14 k€ - 23 € / flat
Total of operating cost per year:	24 k€ - 20 € /flat

### Individual heating systems

In the **Moulins** centre, many dwellings are heated with an individual heating system using gas and it was planned to evaluate the behaviour of a semi-dozen of tenants using this kind of heating. Negotiation has been undertaken with the gas provider, but, at this time, it was not possible to obtain the data transmission of the six meters by the gas provider. For this reason, the data

collection is not yet implemented. In case of impossibility to conclude an agreement with the gas provider, it is planned to install a second gas meter after the gas meter owned by the gas provider on the network owned by the landlord. The cost is estimated about 100 € / dwelling.

### Individual heating systems

In **Northern Ireland**, a basic credit meter to measure gas consumption costs around 30€ whereas a prepayment costs around 130€.

### Water data

Specific information on these services is available from the **Angers** pilot. Investment necessary for reading the water consumption data automatically:

- Replacement of 86 hot-water and 86 cold-water meters: 26 k€ - 302€ / flat
- Installation of 86 sensors of meters (hot-water, cold-water, temperature): 7 k€ - 81 € / flat.

The tenant has to pay each month 2.5 €/month/flat for getting data automatically transmitted and using the internet energy portal. What is important to take into account concerning the costs is the operating costs for the tenants. Indeed, thanks to the replacement of meters and to the automatic collection of data, the tenants have no more rent to pay for:

- the service engineer who came to collect the data: 2.34 € the meter
- the renting of the meters (because it is property of the landlord): 11.24 € the meter
- the maintenance of the meter: 9.81 € the meter

By comparison, the annual cost for a tenant who has only a hot-water meter and a cold-water meter pass from 46.7 € to 38.4 € (because there is cost for maintenance of sensors 4.2 € / flat / year and the cost of the energy awareness service). For the flats which need 6 meters, as it may happen, the cost would be led from 140.16 € a year to 84.4 €.

### Electricity data

Specific information on these services is available from the Angers and Moulins pilots. Investment necessary for reading the electricity consumption data in **Angers** automatically is:

- Replacement of 585 electricity meters: Included in the offer of the subcontractor of EDF
- Installation of 585 electric sensors: 84 k€ - 144 € / flat.

In **Moulins**, as regards the partnership with EDF, within the framework of a blanket agreement linked to the program of current rehabilitation, it concerns mainly the replacement of all the meters in place. Indeed, these last ones date from the 1970s and are thus incompatible with the technology organized within the framework of this project. This technical support should then cause no additional cost as far as the replacement of these meters returns within the

framework of a blanket agreement of partnership between EDF and Moulins Habitat.

## **6. INTRODUCING ENERGY AWARENESS SERVICES - REGULATION**

### **Overview**

The information in this section has the primary purpose of helping social housing providers in France, Germany, the UK and in other European regions assess the preconditions for introducing Energy Awareness Services into their housing stock. Information is provided here on relevant legislation and regulation. Meeting legal requirements for data protection is a key to providing acceptable and sustainable services; regulations on billing can have an impact on services and finally there are some differences in the regulatory context of social housing in Member States. Also, some background information is given here on regional differences in energy consumption.

### **Protection of personal data**

Since publication of Directive 95/46/EC, all European Union Member States have transposed the provisions into national legislation to protect the personal data of their citizens. Information on the behaviour of tenants in respect of water or energy consumption can be expected to be considered as personal data in law and to fall under the provisions of the Directive.

### **Principles of the personal data protection in Europe**

Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on "the protection of individuals with regard to the processing of personal data and on the free movement of such data" concerns the harmonisation of national provisions to provide equivalent protection to all the citizens in the EU.

It applies "to the processing of personal data wholly or partly by automatic means, and to the processing otherwise than by automatic means of personal data which form part of a filing system or are intended to form part of a filing system."

Personal data is "any information relating to an identified or identifiable natural person ('data subject')". The Directive goes on to specify of an "identifiable" person, that such person is one "who can be identified, directly or indirectly, in particular by reference to an identification number or to one or more factors specific to his physical, physiological, mental, economic, cultural or social identity"

The rights conferred under the Directive apply to natural persons, not to legal entities which are not natural persons such as corporations. The Directive does not distinguish between the public sector and the private sector.

### ***Analysis of the impact of the Directive 95/46 on the project***

Directive 95/46/EC has an obvious impact on the services in the project.

The applications of the project are focused upon improving tenant services in ways that may involve personal data. Information on the amount of energy or other resource a tenant consumes and on the time of consumption, if this

information is linked to information about their identity - name, address etc., is clearly personal data and subject to the provisions of the Directive. However, it is necessary to study not only Directive 95/46/EC but also national laws enacted for its application, as these may introduce additional requirements for data protection over and above those in the Directive. This is because, as announced in Recital (9), Member States have been left a "margin for manoeuvre"

We recall here the binding character of European Directives on Member States to implement their minimum requirements in an appropriate manner in their national law(s). Directive 95/46/EC prescribes a final result, leaving to the Member States to determine how best to reach that point. It poses as an objective that "the level of protection of the rights and freedoms of the people with regard of the processing of these data must be equivalent in all the Member States", in particular in respect of rights to privacy, even if each national legislation has to specify the conditions that must be met before processing such data.

Directive 95/46/EC defines the principles relating to the nature of personal data and to the adequacy of controls for their processing, the information of involved people, their right of access, their right of opposition in certain cases and to the confidentiality and the safety of the processing. In addition, it specifies the jurisdictional recourse open to the people as well as the rules of responsibility and sanctions. It describes finally the obligations of notification of the personal data processing and the conditions of their simplification on certain limited assumptions.

The provisions of Directive 95/46/EC and its transpositions therefore apply to the SAVE@Work4Homes project. The analysis which follows underlines those which are in connection with the SAVE@Work4Homes projects and specifies conditions for their implementation. Obligations resulting either from the Directive, or from national legislation already enacted or proposed are included in a synthesis table synthesis.

### ***Honesty and transparency***

As a principle of honesty in the collection of personal data, the Directive specifies that personal data collected must be adequate, relevant and not excessive in relation to the purposes for which they are collected and/or further processed.

Transparency provisions of the Directive include the obligation to inform the person affected by automated processing of the identity of the operator, the purpose pursued by the processing, any mandatory or optional aspects of answers given and of the consequences of the failure to reply, as well as identifying other recipients of personal information.

Respect of the rights recognised to individuals from whom information has been collected:

- right of access, concerning collected information,
- right of correction, on this information,
- right of opposition to the collection and the processing, in particular right of opposition to the processing for the purpose of direct marketing or to transfer to third parties for this purpose.

### ***Consent requirement***

According to Article 7 of the Directive, processing is allowed only if the person "unambiguously" gave their **consent**. Such consent is specified as "any freely given specific and informed indication of his wishes by which the data subject signifies his agreement to personal data relating to him being processed".

Processing without consent by the person is allowed under the Directive for particular cases specified in Article 7, including where "processing is necessary **for the performance of a contract** to which the data subject is party or in order to take steps at the request of the data subject prior to entering into a contract". Here, consent is given by implication.

Furthermore, processing is permitted following Article 7 without specific consent where "necessary for the performance of a task carried out **in the public interest**".

### ***Confidentiality and safety of personal data processing***

The person in charge of the data processing (the controller) must respect the following obligations:

- To implement technical and organizational measures providing a level of security appropriate to the risks (and commensurate with the state of the art and their cost) to protect personal data against
- accidental or unlawful destruction or accidental loss,
- alteration, unauthorized disclosure or access, in particular where the processing involves the transmission of data over a network, and
- all other unlawful forms of processing.

To give the instructions necessary to the respect of the confidentiality of the data processing with respect to all the contributors (internal and subcontractors).

To conclude with any subcontractor processing personal data a contract imposing the above obligation to technical and organisational measures and requiring processing take place only under the instruction of the controller.

To check technical safety and of organisation with respect to the subcontractor.

### ***Nature of the personal data***

Personal data are collected and used by the majority of the partners of the project. The personal data connect

- name of a tenant,
- address of a tenant, and/or
- other identity information about a tenant

with

- water and energy consumption amounts
- temporal profiles of water and energy consumption
- internal temperature of accommodation.

The processing of certain personal data which is particularly sensitive is prohibited by Directive 95/46/EC (Article 8). This prohibition relates to data which reveal racial or ethnic origin, political opinions, religious or philosophical convictions, trades-union membership, and data concerning health or sex life.

It is not expected that any of the personal data used in the project are regarded as sensitive within the meaning of Article 8 of the Directive.

### ***Important consequences for the project***

An important consequence is that the person concerned should give explicit consent to the processing of such data. It is advisable attentively to check the national rules in the legislation text of transposition of the Directive. The level of safety provided for these data must be appropriate to risks arising out of the treatment and the nature of the data to be protected.

### ***Obligation of notification to a supervisory authority***

Notification made by the controller to a supervisory authority must be done before the implementation of the processing. Exemption from this obligation of notification or its simplification is possible on certain assumptions only.

For example in the context of the site projects, the following cases of exemption can be retained:

- processing which is not likely to attack the rights and freedoms of the concerned people (for example technical complaints process, digital check apartment report)
- when a person, seconded to the personal data protection is indicated in the company by the person in charge for the processing, in accordance with the applicable national law.

Finally, certain processing relating to sensitive data is subjected to preliminary authorisation, delivered by the control authority, under conditions specified by the national law.

Rules applicable to the processing of personal data according to the Directive 95/46/EC and national laws:

Site	Applicable Principles Honesty and transparency	Prior consent (see national law)	Safety : Confidentiality and safety	Sensitive data (see national law)	Notification to control authority (see national law)
Angers	YES	YES	YES	NO	YES
Belfast	YES	NO	YES	NO	NO
Berlin	YES	YES	YES	NO	YES
Frankfurt	YES	YES	YES	NO	YES
Karlsruhe	YES	YES	YES	NO	YES
Moulins	YES	YES	YES	NO	YES

## **Specifics of national legislation**

### ***France***

The French legislation, recently changed by the law n° 2004-801 of August 6, 2004, relating to the protection of the physical people with regard of the personal data processing and amending the law n° 78-17 of January 6, 1978, relating to data processing, to files and to freedoms precise that:

it is forbidden to process data relating to health,

but, the banning of collection of information relating to health can be raised if the person gave his express consent,

It is also the case for the treatments necessary to administer care or treatments which are implemented by a member of a profession of health or by another person to who imposes the obligation of professional secrecy following the article 226-13 of the Penal code.

On the other hand, the bill subjects to mandatory declaration the processing which comprises appreciation on the social difficulties of the people.

### ***Process of the personal data protection in France***

The process is, in principle, the same in each member's state, but may differ on some detail points. Wherever possible, people are informed at the time of collection of their data. In principle, we must seek the consent of the person to use any information that identifies. The data that we deal must be accurate, complete and updated.

Except some particular cases, it is not allowed to collect sensitive data (racial or ethnic origin, political opinions, religious or philosophical, trade union membership, and data relating to the sexual life or health). In France, the collection of personal data by a fraudulent, dishonest or illegal method is punishable by 5 years in prison and a fine of € 300 000. (Section 226.18 of the Criminal Code)

"Art. A 7-processing personal data must have the consent of the person concerned or meet one of the following conditions:

- 1 ° compliance with a legal obligation incumbent on the controller;
- 2 ° safeguarding life of the person concerned;
- 3 ° the execution of a public service mission vested in the head or the recipient of treatment ;
- 4 ° the execution, or of a contract to which the person is a party or precontractual measures taken at the request of the latter;
- 5 ° the realization of the legitimate interests pursued by the controller or by the recipient, subject not to underestimate the interest or the fundamental rights and freedoms of the person concerned.

This principle is to be opposed to the exceptions cited by the text and reproduced above. The draft study pursued by SAVE@Work4Homes could fall under the exception in the French text cited in 5°, which was highlighted by commentators of the European directive, resumed here by French law, it weakened significantly the scope of the previous duty.

If there is reason to be cautious to respect the text literally and, therefore, whether we should seek to obtain the agreement of the people as far as possible, it may be observed that on the one hand the personal data protection authority (CNIL in France), in the presentation of the rights of persons makes no such obligation in absolute terms, no doubt aware of the difficulties of its implementation, and, on the other hand, Article 8 of the French Law expects the express consent of the people only for \*very\* sensitive data (racial, political or religious beliefs...).

Thus the filling in a questionnaire on personal data with the person concerned, after having duly clarified its right to opposition, data access and correction, must be treated as part of his agreement.

On the other hand, the use of anonymous data has to be sought at the earliest possible stage of data processing where it can be done.

Finally, we will be more vigilant, particularly in the case where data were indeed personal data, but they were not collected directly from the people involved but from third parties. On that occasion, it will be verified that the user of the treatment has been identified as a recipient of personal information for the collection and the consent of the people to such a transmission

### ***United Kingdom***

The Data Protection Act of 1998 retains the concept of sensitive data, in particular in the field of health. For the processing of these data, the law of 1998 envisages the assent of the concerned person or the need imposed by the law or medical reasons.

There are eight principles put in place by the Data Protection Act 1998 to make sure that information is handled properly. These are that data must be:

- fairly and lawfully processed;
- processed for limited purposes;
- adequate, relevant and not excessive;
- accurate;
- not kept for longer than is necessary;
- processed in line with your rights;
- secure and not transferred to countries without adequate protection.

By law data controllers have to keep to these principles.

### ***Germany***

The Federal Data Protection Act (Bundesdatenschutzgesetz BDSG) was enacted in December 1990, before the Directive, redrafted in January 2003 - to transpose the 95/46/EC and valid today in a version last amended in August 2009.

The BDSG apparently accurately transposes the Directive, however, there is the complication of a set of distinctions between rights and obligations of controllers depending whether these are public or private (§ 2 Öffentliche und nicht-öffentliche Stellen).

## **Application to SAVE@WORK4HOMES Services**

### ***Tenant portals***

Tenant portals must be safe and access kept confidential because of the protection of the personal data there. This is all the more important if the portal contains contractual or bookkeeping data of the tenant's contract. Access to the data must be secured by a password protected login.

### ***Self-assessment tool***

The self-assessment tool collects only anonymous data, so we are not dealing with privacy protection issues. Depending on the decision made, questionnaires may be available to anyone or only to a specified group of users.

In the last case a set of users has to be defined and each user has to login before answering any questions.

### ***PDA-based tools***

There appear to be no legal obligations arising from application of Directive 95/46/EC to the use of PDAs by the staff of the social housing company using these to provide information and explain to a tenant how to save energy by a change of behaviour.

### ***Information services concerning collective space heating***

For this part of our project, we do not have any problems about the confidentiality of the collected data. Indeed, expenses linked to heat are directly managed by charges to tenants, after regulation, maintenance costs linked to the heat to cover the amount charged by the supplier of energy.

### ***Information services concerning individual space heating***

In this case, the measured temperature as the gas consumption must be considered as personal data. So in respect of the French law about "data processing and freedom", Moulins Habitat can not use the personal data of the tenants. So, we only use the global consumption and the average temperature of each building.

There will have a contract between the housing company and each tenant who subscribe to the service. And if the landlord needs to use some personal data, there will have a written authorization of each concerned tenant.

### ***Information services concerning individual electricity consumption***

The providing of electricity data in **Germany** is difficult because of the variety of suppliers. The German tenants may choose their suppliers of electricity freely, so that the housing company potentially has to contract with many more than one supplier.

The situation is the same in most of the **UK**. Whilst householders in England, Scotland and Wales can choose their electricity supplier from a number of companies, in practice, in Northern Ireland there is only one company available, NIE. The regulatory regime in Northern Ireland allows new companies to supply

electricity here, but in practice no new companies have chosen to enter this market, presumably because it is regarded as too small.

In **France**, a very few tenants have chosen another electricity provider than the incumbent EDF. So, it is possible to contract with this electricity provider, but, in that case, it is also very difficult and very long to negotiate a contract with this supplier without counterparts to help it to finance the replacement of the old electricity counterparts (exchange of saving energy certificates, choice of electricity for heating energy in the new buildings).

In **Angers**, negotiation was facilitated by the fact that, at the beginning of the project, the provider of the service (Effineo, previously Edelia) was a subsidiary of EDF. To implement the providing of electricity data, Le Toit Angevin has engaged a special approach near the CNIL - National commission for liberty and processing. Indeed, the housing companies have to declare the process to collect and secure the data (done by Le Toit Angevin in Angers). The tenants have been informed of this action of collection of their personal data. They also have, at every time, the possibility to ask for stopping the data collection. In the fact, Le Toit Angevin does not have the possibility to access to the personal data directly, thus it is its service provider Effineo which keeps this information.

### ***Information services concerning water consumption***

Water consumption data can be considered as personal data. Their treatment is relevant of the process of the personal data collection, with a declaration to the authority (in France CNIL -National commission for liberty and processing).

In Angers Le Toit Angevin has made this approach and has presented it as a landlord in charge of readjustment of the water rent in La Roseraie. The investment cannot be recovered when the investment is made by the landlord, but authorized in a rent formula. The operating costs can be charged to the tenants in France (planned in the "running cost" decree).

## **Heating billing regulation**

The systems of regulation are very different between the three countries.

In **Germany**, the option (and responsibility) of the housing company to provide information about individual consumption of heating energy or domestic hot water is only given in buildings with centralized heating supply (be it gas or oil central boiler stations, district heating or the use of other new technologies, such as solar, wood, heat pumps etc.). In other cases (individual boilers or other unitary heating equipment), the housing company is not involved with energy supply or energy costs.

However, in Germany central supply with heating energy and/or domestic hot water is the dominating solution in the residential sector: more than 80 % of rented buildings have such a system today. In these cases, the energy provider (gas or district heating utility, contractors, fuel oil or wood pellet suppliers etc.) bills the housing company in a first step. The housing company is responsible for subsequently recovering the costs of energy supply from its tenants. This second step is strictly regulated by an ordinance ("Verordnung über die Heizkostenabrechnung"), which defines the procedure how to calculate and to "distribute" the costs of heating energy and domestic hot water supply to all tenants within one building. In addition, it is defined in this ordinance, which

costs – besides the direct energy costs – are allowed to be billed to the tenants by the housing company.

The ordinance requires that the consumption of heating energy and domestic hot water is measured individually over a given billing period (usually one year) and then the resulting costs are distributed to all tenants. At least 50 % of these costs have to be billed according to the measured individual consumption of the tenants. For the remaining costs, other criteria, such as heated area, may be used. In the residential sector, the only exception for this requirement is buildings with a heating demand being smaller than 15 kWh/m<sup>2</sup> (which is the standard of the German "Passivhaus").

According to this ordinance, the costs for the technical equipment necessary to fulfil the requirements for the measurement of individual consumption of heating energy and domestic hot water and its operation, including costs for data processing and billing, can be transferred to the tenants. By the last change of this ordinance, published in 2008 and being in force since 1st January 2009, also an evaluation of consumption patterns and cost development over the last 3 years is recommended, and the costs connected with this evaluation are allowed to be included into the billing balance. Based on this new regulation, housing companies are allowed to include the additional costs arising from establishing and operating a tenants portal, which provides information on individual energy consumption patterns, into the heating bill. It is up to them to decide, if and to which extent they make use of this option.

Since the purpose of the tenants portal is to enable tenants to realize energy (and corresponding cost) savings, the additional costs of the tenants portal that are billed to the tenants should be (significantly) lower than the average savings potential. This should be kept in mind by the housing companies.

The **United Kingdom** is represented in the project by Northern Ireland. None of the Northern Ireland Housing Executive stock including the flats has a community or district heating system or any system that is centrally managed on behalf of tenants. Householders purchase their gas, oil coal or electricity from suppliers directly and the bill is between these two parties exclusively. So, the energy is provided and billed by the energy providers without any intervention of the landlord.

In **France**, communal heating systems have been largely used before the first oil crisis, but after 1975, individual heating systems have been systematically used, except in the last few years where some communal heating systems have been developed.

Among the 4,200,000 dwellings managed by the French social housing companies, under 2,000,000 dwellings are centrally managed (800,000 dwellings with a district heating system, 1,200 000 dwellings with a gas collective space heating system and about 100,000 dwellings are served by an oil or solid fuel communal heating system (see the scheme on following pages). Some have partly communal and partly individual space heating systems.

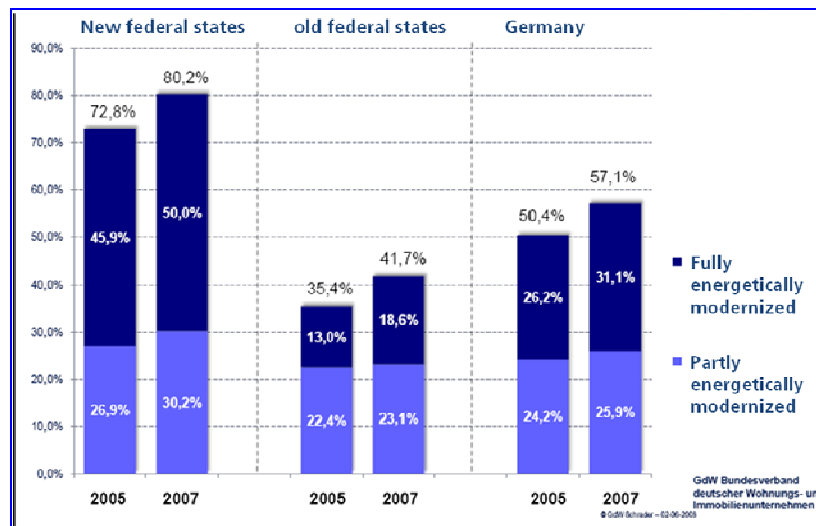
Among the 2,000,000 dwellings with a collective heating system, a large part is equipped with an individual water heating system. In the individual heating systems, the energy is provided and billed by the energy providers without any intervention of the landlord.

In the collective heating systems, the energy provider bills the landlord who has to recover from the tenants the costs of the heating service. Generally, the costs are shared between tenants proportionally to the square meters of each dwelling. In some cases (<1%), the costs are shared between tenants partly (50%) with square meters and partly with evaporators placed on each radiator. In very exceptional cases, a calorimeter is used to share the costs to the tenants. The metering costs can be recovered from the tenants when they are rented by an external provider, but the investment costs of a metering infrastructure cannot be recovered when it is financed by the landlord.

## Energy consumption in European households

57% of **German** housing stock has been partly or fully modernized in terms of energy systems since 1990. 31% of dwellings are fully modernized with improved insulation, new windows and new heating systems or boiler. 26% of dwellings are partially modernized - new windows or partial insulation or new heating system.

**Figure 12: Dwellings modernised in respect of energy consumption since 1990 (GdW housing companies)**



In Germany, a part of housing companies stock shows an energy consumption of less than 70 kWh/(m<sup>2</sup>a) in the whole building stock and has reached the low-energy standard for all rented buildings in this way.

In the new federal states an important potential for energy modernization has been used.

As a result the energy consumption for rented dwellings in multi family buildings is approx. 160 kWh/(m<sup>2</sup>a) in average. This result was given by analysis of energy certificates based on the energy performance of buildings directive.

The German energy performance certificates give the energy consumption for heating and, if centralized, for hot water for a three year average (degree-day rectified).

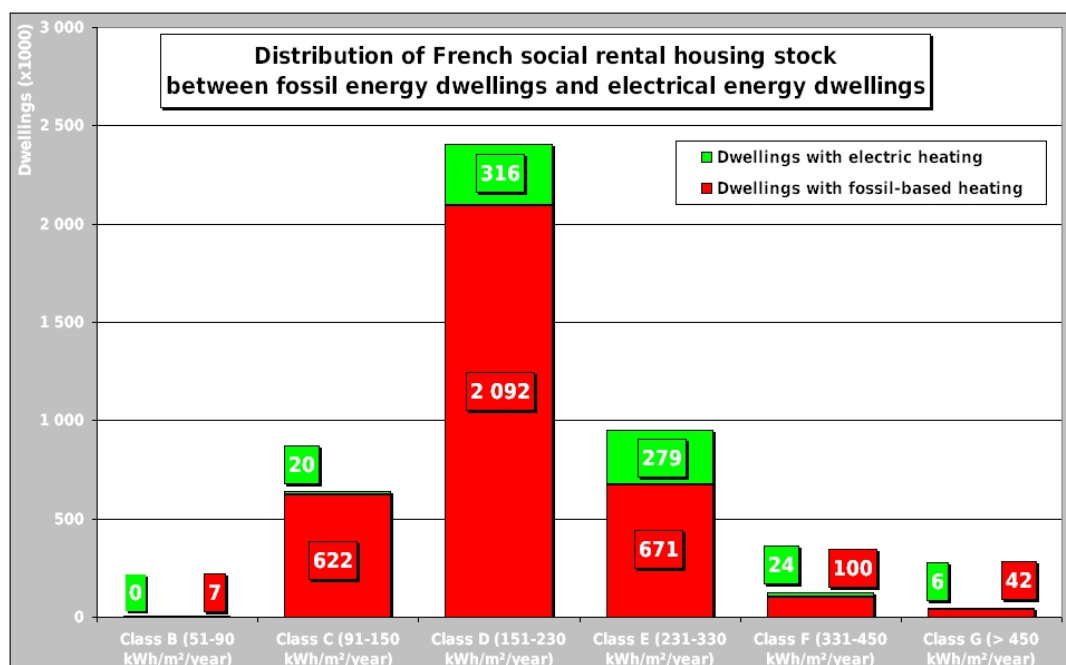
In **France**, the retrofitting of the existing housing stock, since the first energy crisis in the middle of the 1970s, has always made a significant contribution to

energy-saving in the work carried out. With the support of the authorities setting the subsidy rate for energy-saving works at 40% ("Fonds Spécial Grands Travaux" - special fund for major works) at the beginning of the 1980s, this contribution had been noticeably reinforced. This is why the social housing stock, which houses 16% of the population, now accounts for only 11% of the CO<sub>2</sub> produced by the residential sector.

In 2006, the median energy consumption of the social housing stock (heating + hot water) was 170 kWh/m<sup>2</sup>/year<sup>2</sup> of primary energy as opposed to 240 kWh/m<sup>2</sup>/year of primary energy for the entire residential housing stock, whereas at the beginning of the 1980s, a survey carried out by Union sociale pour l'habitat covering 750,000 dwellings placed the median social housing stock consumption at 250 kWh/m<sup>2</sup> of primary energy.

This progress over the last 30 years and the contribution of the housing stock constructed after 1975 with increased thermal standards have therefore enabled median energy consumption related to heating and hot water production to be reduced by a third (32%). This progress required important investment to insulate buildings and modernise heating and hot water production and distribution facilities. The investment was generally greater than €16,000 (in 2009 terms) per housing, two-thirds of which was devoted to improving energy efficiency. It involved more than half of the housing stock present in 1975 (i.e. 1,150,000 dwellings over 2,300,000 built in 1975). The stock build after 1975 represents in 2009 nearly 1,900,000 dwellings which are generally correctly insulated (new thermal regulation applied from 1976), and with a significant part in it of electrically heated dwellings (600,000 dwellings built after 1975).

**Figure 13: Fossil energy vs. electrical energy in France**



<sup>2</sup> In France, the average of the degree-days is about 2500. They varies from 1300 (Cote d'Azur) to 3 000 (Alsace).

Three-quarters of the housing stock in France is classed into B, C and D categories of the energy performance certificate (<230 kWh/m<sup>2</sup>). Nevertheless, a quarter of the housing stock remains in classes F, G and H (> 230 kWh/m<sup>2</sup>).

This housing stock heated with fossil energy will be retrofitted before 2020, but a large part of the housing stock has to find other solutions with very low cost investment to save enough energy to reach the French sustainable development goals in 2020.

In the **UK**, the energy efficiency of dwellings is measured by the Standard Assessment Procedure (SAP) on a scale of 1 to 100 with 1 being extremely poor and 100 being excellent. In Northern Ireland in 1996 the average SAP for all housing was 35 but by 2006 this had improved to 52. The improvement was due mainly to large scale fuel switching from inefficient heating systems like coal to more energy efficient systems like natural gas or oil. Large scale insulation programmes also contributed to the improvement.

The breakdown of the SAP score by housing tenure is as follows:

TENURE	No of Dwellings	%	SAP score
Owner-occupied	468,860	66.5	51
Private Rented/Other	80,870	11.5	52
Housing Executive	93,440	13.3	60
Housing Association	21,530	3.1	69
Vacant	40,300	5.7	41
TOTAL	705,000	100.0	52

As can be seen from the table above, social housing (Housing Executive and Housing Association) has a higher SAP score than private housing, largely due to much better standards in insulation in these tenures.

## Social housing and regulatory context

### Germany - social housing context

With the withdrawal of the German federation out of the promotion of social housing, the stock in that sector has decreased continuously. The number of dwellings reduced from 4.2 millions in 1978 to 2.1 millions in 2001. In the 1990's the social housing sector attached importance to the promotion of programmes which tried to improve the flats and the residential environment in a more child-, family- and women-friendly way. At the end of the 1990's the focus was placed more and more on energy related topics. Social housing tenants can – in case of need - make use of two different kinds of social benefits in Germany:

- housing and heating allowance,
- means-tested transfer payments.

Housing benefit is only paid out to non-transfer payment recipients by the German federation.

Means-tested benefits are:

- unemployment benefit II (cover both the unemployment aid and the social aid)

- basic security in old age and in cases of reduced earning capacity

Transfer payment recipients' accommodation costs are paid by the municipality up to a reasonable amount.

### **Germany - regulatory context**

The German Energy Industry Act in 1998 implicated the deregulation of the energy market. Since September 1999 each private customer can choose the electricity supplier freely. Since April 2007 the gas provider can be changed too. Since September 2008 tenants even could choose the metering company (installation of the meter, maintenance and metering). From January 2010 is planned that all new connections to the energy grid must be provided with "intelligent meters". Those meters measure actual consumption in real time only. In addition to this since January 2005 new programmes of the German KfW promotional bank (Reconstruction Loan Corporation) support new energy saving buildings, sustainable refurbishments of the building stock, photovoltaic units, etc.

### **United Kingdom - social housing and regulatory context**

In the United Kingdom, unlike other European countries, social housing is generally not based on communally heated blocks of flats/apartments. It is mainly individually heated houses including detached, semi-detached, or terraced dwellings. There are blocks of flats and apartments but only a small minority of these would have communal heating systems. All social housing tenants in the UK are responsible for paying their own heating and electricity bills to the supplier directly – the landlord has no role in this. The landlord's role is simply to provide the heating or electricity system, repair and maintain it, but takes no role in billing or metering.

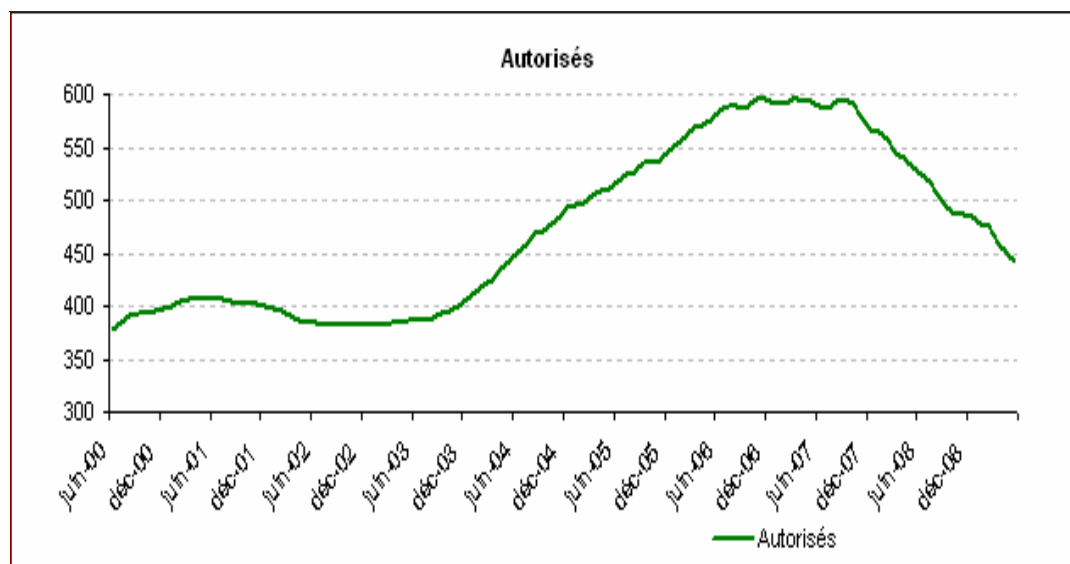
Gas and electricity are metered fuels and tenants receive quarterly statements on consumption but this data is not shared with the landlord by the utilities and more recently, cannot be shared for Data Protection reasons. Coal and oil are non-metered fuels so tenants using these fuels must manage their own consumption data by retaining records of invoices when they buy fuel – in practice the vast majority of tenants do not do this and, if asked how much fuel they use, would have to estimate their annual fuel consumption. Also in the UK there is a low level of internet access among social housing tenants.

In the United Kingdom, the vast majority of social housing organisations are not responsible for supplying energy to tenants. They simply provide a heating system, thereafter the contract for supplying energy is between the tenant and their chosen supplier. Landlords do not receive copies of tenants' bills and energy suppliers would have no reason to send them a copy. A further barrier to social landlords receiving bills is the Data Protection Act which restricts the sharing of personal data with third parties. The exception to tenants bills being handled by landlords would be in the tiny proportion of blocks of flats which have communal heating systems. However, there are none of these in Northern Ireland Housing Executive stock.

## France - social housing context

After three years of expansion in the construction sector from January 2004 to December 2006, and one year of stability (2007), construction is declining since the beginning of the year 2008. But it is not the case for social housing which is still progressing (99 000 built in 2008 and 120 000 planned in 2009).

Figure 14: Construction in France



(Source: SOeS, Sit@del2 of the French Ministry)

Some ten million people live in the rental Hlm stock and every year 450,000 families are accommodated in new housing or released by their occupants. In today's society, marked by the rise of insecurity that affects not only employment and income but also access to housing, Hlm remain indispensable. They are designed to accommodate the diversity and dignity for those who have difficulty accessing housing at market conditions. They are also key actors in social and urban cohesion. They also plan to produce, manage and adapt housing at high technical, architectural, urban and environmental quality. Hlm movement has made sustainable development one of its priorities in the fields of energy and preservation of natural resources.

Even if the level of energy consumption of the Hlm stock is already 30% below the average of other homes, the Hlm Movement will implement a program to improve thermal insulation of 800,000 flats in 10 years. It would also prefigure the future in the new buildings by a program of energy excellence: production of housing predominantly under label, experimental operation of "low consumption-building and at positive energy." It will develop the use of renewable energy. For water, the Hlm organisations will equip their flats with saving equipment. They will work involving staff and tenants on "eco – Citizens" behaviour vis-à-vis natural resources

## France - regulatory context

During the last months, the legal context is moving with the consequences of the "Grenelle of Environnement". These recent changes will modify significantly the conditions of realisation of the work done during our project.

The main changes are notified here:

The new law on housing sector ("MOLLE" law) allows, now, the use of a new line on the bill ("Ligne à part") to permit reimbursement of the investment with the agreement of the tenants. The tax system imputation has been changed (Art. 47) to permit a better usage of this option. The law was published on the 25 of March 2009.

The "Grenelle I" project of law will introduce a big programme of energy efficiency for new and existing buildings and will address some other legal and economic issues. It has been adopted only in the first reading by the "Assemblée Nationale" in October 2008 and by the "Sénat" in February 2009. It has been adopted in the second reading by the "Assemblée Nationale" the 17th of June 2009 and will be examined by the "Sénat" in the first day of July. So, it is not yet validated and published in June 2009.

The "Grenelle II" project of law has only been deposited before the Parliament and will address other issues and will probably introduce more incentive measures that will permit more easily the development of the Energy Awareness Services.

Due essentially to the action of the French USH, the recent changes will enhance significantly the conditions of generalisation of the work done during our project.

## 7. ENERGY AWARENESS SERVICES - LESSONS LEARNT

### Introduction

Energy Awareness Services were provided in the project through specially built internet portals to tenants at two sites in France and three in Germany - Angers, Moulins, Frankfurt, Berlin and Karlsruhe. The experience of the five sites in setting up the services and evaluating their impact was quite varied. Dependency in the approach at the French sites on cooperation with energy utilities brought problems of timing, to the extent that service delivery at one site was severely delayed, and evaluation at the other so prolonged that evaluation data is too thin for any clear picture of impact to be drawn. A major focus of German Tenant Energy Portals was on providing feedback on heating energy consumption. Though measurement infrastructure and service delivery systems are in the hands of the housing providers, some sites met unexpected problems of low rates of usage. Instead of the expected welcome by tenants of services as meeting their real desire for information - as had been shown in the careful surveys at the outset of the project - work became that of persuading tenants to make proper use of the services. Nevertheless, services could be delivered fully at all sites, and useful lessons were learnt regarding appropriate presentation. Also, where data on change in consumption was achieved, there is evidence of a positive impact of the project's Energy Awareness Services on tenant energy behaviour.

### Tenant Energy Portals in Germany

The following sections provide some information about lessons learnt in service delivery and from evaluation of service use from each of the German sites.

In **Berlin**, 102 tenants in two different buildings were equipped with a radio metering system for heating, enabling the Tenant Energy Portal service to be provided to them. Once the service had been implemented (first release), all were contacted to participate in the test of service provision. However, the response was poor.

After the first release of services, only one tenant signed the consent form to receive the service. It became clear that the fact that very few tenants had internet access would be critical at this low level of response. Therefore for the second release of the services, the option of a paper version for tenants without internet access was introduced. Also, communication of the service possibilities was improved. The high energy prices at the time of the introduction of second release services can also have played a part.

After service improvement and further information, the number signing their consent to the services grew to 13. Six of the tenants accepting the service decided to receive the information by letter and seven via the Tenant Energy Portal.

Despite the improved participation, it is not easy to explain why so few tenants were willing to participate in service provision. The services offered were additional, they were free of cost and tenants were even offered small presents

as an incentive. The survey conducted among tenants showed a high interest in environmental issues in general and in detailed information on energy consumption in particular.

The suspicion that younger and better educated tenants are more willing to participate cannot be proven as the two buildings, the only ones equipped to provide the service, both have a tenant population with few younger or better educated tenants.

One possible explanation is that despite our improved efforts to explain the service, tenants were unable to appreciate what it would be like to be presented with information on their own energy consumption. We are only able to show new tenants anonymous data from some other tenant to illustrate the service. Our understanding of data protection legislation in force is that the service can not be provided at all without explicit informed consent. Tenants could therefore not be shown their own data until they had consented to take part.

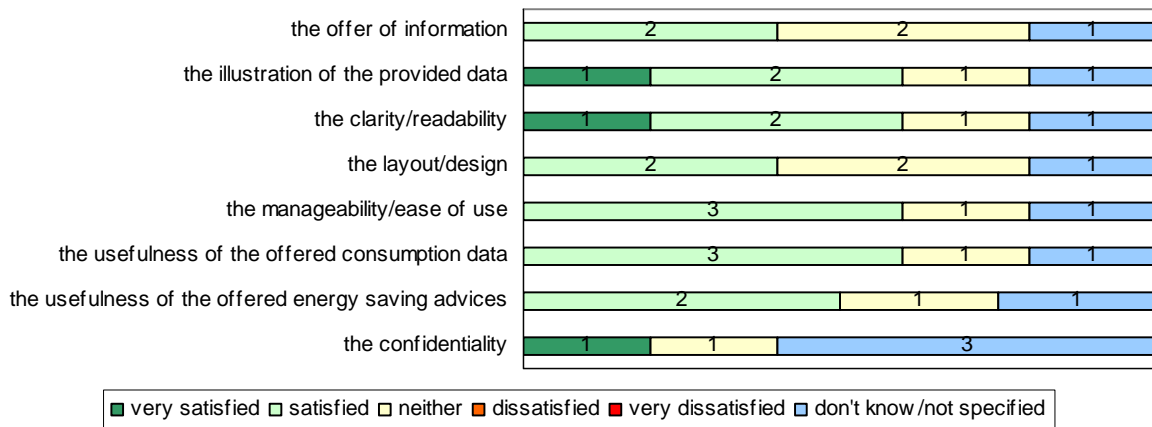
For a further increment of the number of participants, a communication with tenants seems to be the most promising way. Also, it will be important to help tenants who already use the service to explain to interested tenants what they get out of the service.

Quantitative data on usage of the services in Berlin is available for the seven participants who chose to use the Tenant Energy Portal. Connection statistics showed that only three of the seven really used the portal. The other four apparently did not connect, despite having received all the necessary information by letter and some reminders by email (in three of four cases).

Although we do not know exactly how the participants used the paper version of our service, we suspect that access to the information opening a letter was found easier than connecting to the tenant portal.

Those participants who used the portal focussed basically on the simple presentation of their raw consumption data. They accessed information on heating consumption more than that on hot and cold water. The display showing heating consumption corrected for changes in outside temperature did not get much attention. The third important component of the Tenant Energy Portal - the self assessment tool - was mostly ignored by tenants in these two buildings. Only one tenant went through the questionnaire completely. Other tenants could be shown to have hit the page as well, but they stayed there for much too short a time to have been able to complete the assessment.

**Figure 15: Satisfaction with the Energy Awareness Service**

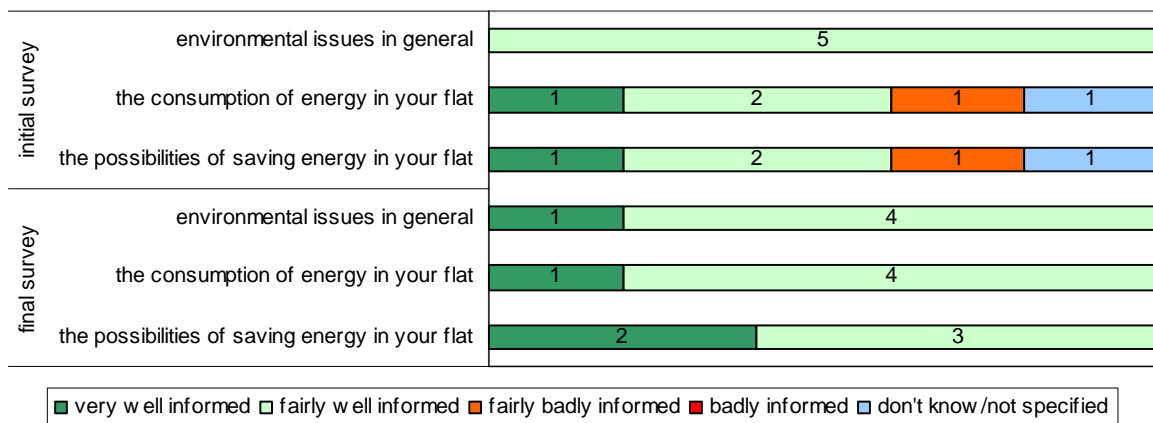


Question: How satisfied are you with...?; absolute number of respondents

After using the service, three tenants now know more about the consumption of energy and the possibilities of saving energy in their homes. One tenant is now more interested in energy saving issues than before.

As can be seen from the chart, primarily the tenants are interested in tips for an energy saving behaviour and the current consumption figures of domestic hot water and heating. With regard to the knowledge about the consumption of energy and the possibilities of saving energy, tenants felt better informed after the implementation of the service.

**Figure 16: Information about environmental issues, initial and final survey in comparison**



Question: How informed do you feel about...?

To detect the desired change in energy-related behaviour, we compared resource and energy consumption during service provision with consumption the year before. Differences in heating consumption were corrected for the change in outside temperature (degree days). One service user was a new tenant with no

prior data to compare with, so that the results can only be analysed for twelve service users.

	Version	Connections	Warm water	Cold water	Heating
<b>Total</b>	Internet (7) Paper (6)	19	-4,17%	-7,85%	-9,31%
<b>Control Group</b>			-4,77%	-0,50%	-8,24%

As to be seen from the above table, heating consumption behaviour improved more in the service user group than in the control group. The control group consists of the 82 tenants of the same two buildings who did not subscribe to the service. Also the new tenant who used the service but had no previous history showed very low consumption figures. The comparison is slightly improved when we eliminate the extremes by taking out the two highest and two lowest values. However, the difference between the two groups remains small and the danger of a spurious artefact remains real. Indeed, in case of the warm water consumption, savings made in the control group actually slightly exceed the savings in the group of service users.

The services developed in this project aim at a change of the tenant's energy consumption behaviour. There are of course a number of other factors that influence energy consumption. One such factor, outside temperature, which of course has a massive effect, could be controlled for. Others, such as life events, were not - we did not attempt to measure if a tenant spent more time at home because of an illness, if one went on vacation, had visitors etc.

Such events may of course have a strong effect on heating energy consumption. If the sample had been big enough, we could have confidence that such incidents occurred equally often in both groups. Having only 12 results from service users, this is clearly not the case. Due to the small number of participants and the small difference between the groups we have insufficient statistical confidence in the indication of the effectiveness of our service.

Although first tendencies of improved consumption patterns and heightened awareness could be shown, it also exposed the difficulties a project like this brings. To change somebody's behaviour is clearly a long-term task. Offering the possibility to control their own consumption is a first and very important step. It appears that in the early phases more continuous communication with tenants is required to remind them of opportunities to save energy and motivate them to do so.

In **Frankfurt**, heating data was collected monthly for 284 tenants in the period from April 2007 until June 2009. For the analysis, the heating season November 2007 until April 2008 could be compared with the months November 2008 until April 2009.

Out of the group of 284 tenants, 15 tenants agreed to get personalised information with the tenant portal and/or paper based information. These tenants were provided with general information in November 2008 and informed about their monthly heating consumption from February 2009 onwards.

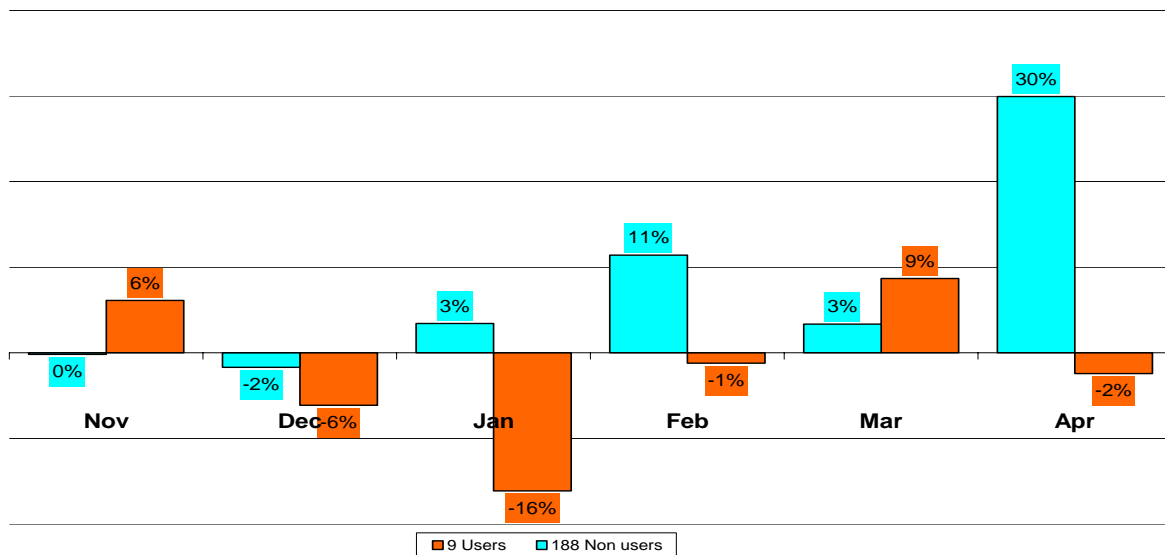
During the project period, validation of the measured data showed a number of cases of missing or wrong values. The metering companies in charge explained that these are due to technical problems in transmitting the data from the

meters in the dwellings to the data collectors in the basements and/or during the transfer from the collector to data processing centre. In addition the meter itself could be the reason. This can only be changed once a year, as at this point in time the billing has to be done only on a yearly basis. In cases where the measured values seem to be wrong, the measuring company simply estimates consumption from previous periods for the billing. If the data collection would be done in shorter periods like during the project and including a validated software algorithm, these errors would be detected quicker and could be corrected.

As a result of measurement faults, several dwellings had to be excluded from the analysis. Other dwellings had a change of tenant and there were periods of vacancy. After these necessary exclusions, consumption data for eight dwellings of service users could be included in the analysis. In the control group, 188 dwellings show reasonable consumption data.

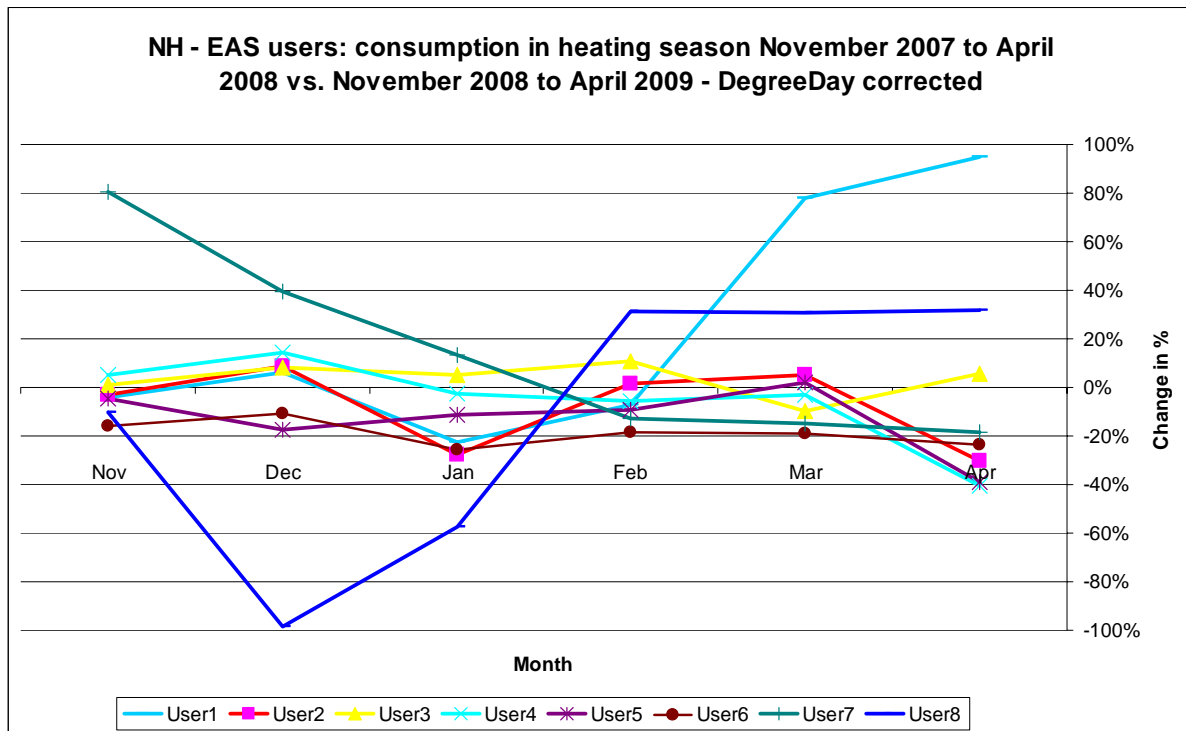
**Figure 17: Differences of heating consumption change (%) between heating seasons - users and non users of Energy Awareness Services**

NH - Users vs. Non-Users of the EAS: % difference between consumption in heating season November 2007 to April 2008 vs. November 2008 to April 2009 - DegreeDay corrected



Comparing the results from the first heating season, the total change in consumption of the user group is 2% whereas the control group has no significant change. However, the chart shows that the user group sees a decreasing consumption in four months whereas the control group saved energy only in December compared to the previous year. Half of the tenants in the user group reduced their consumption whereas the other increased their consumption.

**Figure 18: Heating consumptions evolutions (%) between users of the Energy Awareness Services**



Service users no. 4, 7 and 8 show high levels of change, up to nearly 100%. Others show only minor changes. Analysing the data without the degree-day correction shows even higher differences up to a factor of 3 between the two heating seasons. Variation in consumption by users 3, 4 and 7 might be explained by longer holiday trips, a new baby or other changes in lifestyle, rather than behaviour change brought about by our Energy Awareness Services.

In part due to the small number of tenants in the user group, it is therefore hard to draw overall conclusions about the effectiveness of the service in Frankfurt.

In **Karlsruhe**, services on a Tenant Energy Portal ran from autumn 2007 until May 2008. The portal was offered to the tenants of 2 almost identical buildings, identified by their addresses Kranichweg 4 and Rheinstrandallee 5. The tenants of Rheinstrandallee 5 (36 flats) were only informed about the availability of the new portal and the access procedure. For the tenants in Kranichweg 4 (28 flats), more information was offered, including direct visits by energy advisers from Volkswohnung and additional explanations of their consumption pattern, asking also for feed-back from the tenants concerning usability of the information the portals had provided.

In immediate vicinity, there are two other buildings, Kranichweg 2 and Lindenallee 31, which are also almost identical with the first ones. These 2 buildings acted as a control group: no portal was offered. The consumption of heating energy and domestic hot water was measured here in the same way as in the other 2 buildings.

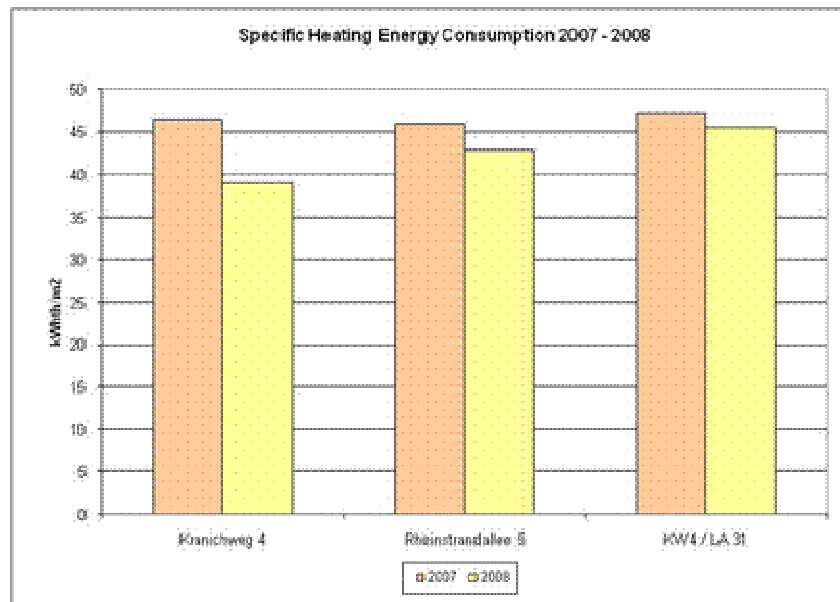
The 4 buildings, built in 1967, provide altogether 136 flats, and have been retrofitted recently to achieve a very good standard of insulation, with an investment of about € 4 million. The "natural ventilation" the flats had before renovation was replaced by a mechanical ventilation system with constant air

exchange rates. As a result, the end energy needed in the common heating plant to cover heating and domestic hot water demand was reduced from an average value of  $> 200 \text{ kWh/m}^2$  before retrofit to about  $80 \text{ kWh/m}^2$ .

As the measurements over 2 periods have shown, the flats display wide variation in their individual energy demands, with a spread by a factor of 3 to 4. These large variations are actually the main reason to believe in big energy conservation potentials by influencing the user behaviour.

Comparing the annual specific demand for heating energy ( $\text{kWh/m}^2\cdot\text{a}$ ) in 2007 and 2008 for the 4 buildings (and taking the average of the 2 buildings without access to the Tenant Energy Portal), the development between 2007 and 2008 is illustrated in the chart below.

**Figure 19: Specific heating energy consumption ( $\text{kWh/m}^2$ ) of the two “portal buildings” and the average of the two other buildings in 2007 and 2008**

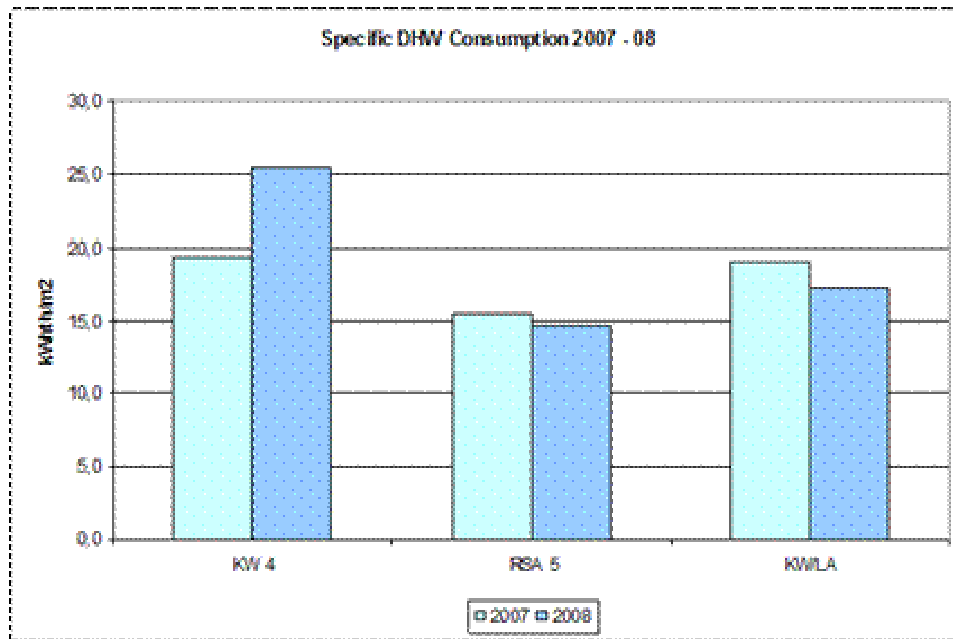


(data adjusted for changes in degree-days)

According to this, the average heating demand of the buildings – being very low in all 3 cases anyway - has been reduced from 2007 to 2008 by 16 % in the case of Kranichweg 4 and by 7 and 4 % for Rheinstrandallee 5 and the remaining 2 buildings (with no portal). This result seems to show a strong effect of the awareness services provided through the portal. However, one has to consider that the number of involved dwellings is low, therefore the statistical evidence is also low, considering the large spread of heating energy consumption of the individual flats, which would lead to a broad Gaussian curve, if evaluated with statistical methods.

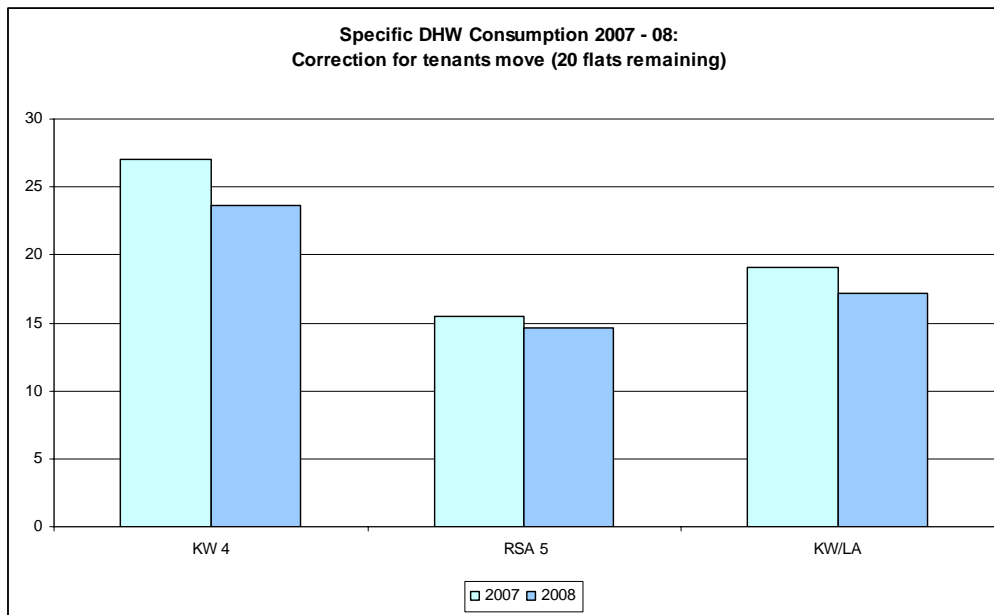
In addition to that, the availability time of the first portal version was between October 2007 and May 2008, therefore, considering the annual consumption – based on a calendar year – leads to a mix of consumption data for times with and without portal availability. The same data evaluation of annual domestic hot water (domestic hot water) consumption gave the following result:

**Figure 20: Specific domestic hot water consumption (kWh/m<sup>2</sup>) of the two “portal buildings” and the two other buildings (average) in 2007 and 2008**



Obviously, there is a big difference – if not contradiction - in the results of Kranichweg 4 (the building with portal and additional communication with Volkswohnung), compared to the heating data. A closer look on the individual consumption patterns of the tenants showed that 7 of the 28 tenants in Kranichweg 4 had been replaced by others during November 2007 until March 2008. These new tenants, being younger and having children, contrary to the rather old tenants they had replaced, had a significantly larger domestic hot water consumption, which resulted in an increase for the whole building by about 25 % in 2008.

Omitting the 7 flats from the consumption data of 2007 and 2008, where tenant replacements had happened, and leaving the data of all other tenants and buildings unchanged, gives a quite different pattern to the results:

**Figure 21 Specific DHW consumption**

Specific domestic hot water consumption (kWh/m<sup>2</sup>) of the two “portal buildings” and the two other buildings (average) in 2007 and 2008, with 7 flats removed from the consumption data for 2007 and 2008 in the case of Kranichweg 4 (see text)

The result of this adjustment shows the desired result. Statistics confidence is too low for reliable conclusions on user behaviour and influence exerted by the availability or non-availability of the portal. The influence of the energy price increase in 2007 should be examined further, and the big difference of the domestic hot water consumption in the 4 buildings would have to be explained.

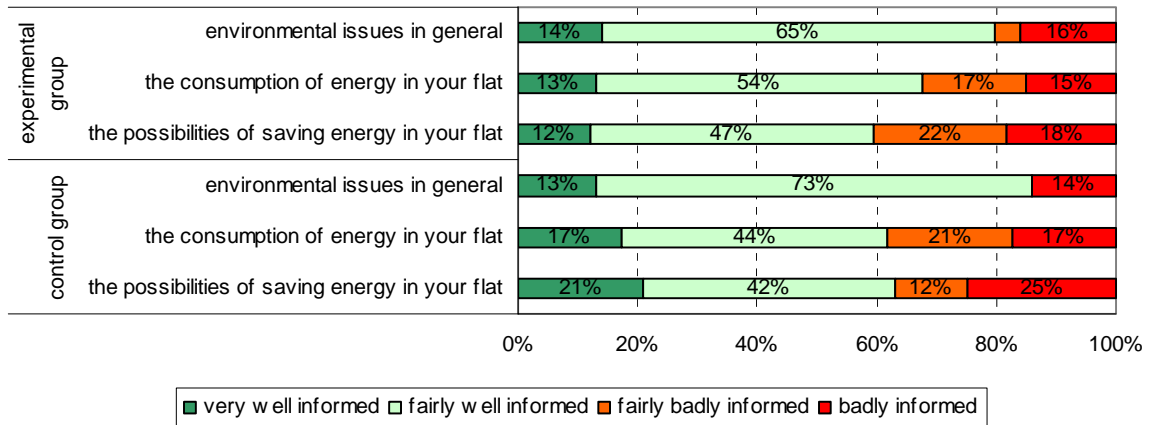
In order to derive meaningful conclusions concerning general saving potentials or quantification of portal effects, more dwellings and a longer observation time would be necessary. With such data, also a sound statistical analysis would be reasonable. Since Volkswohnung and others will implement this portal service, such data will be available in the future.

## Tenant Energy Portals in France

In **Angers**, a Tenant Energy Portal service was provided giving feedback on consumption of water and electricity. The evaluation approach was designed as a longitudinal study with a control group design. The following results from the initial data analysis accordingly are presented separately for an experimental group and for a control group. Both groups of tenants live in similar residential estates. Considering the fact that neither group had received any services, it is unsurprising that initial findings are very similar in both groups, which together can be seen as representing tenants in Angers not receiving any specific advice or service.

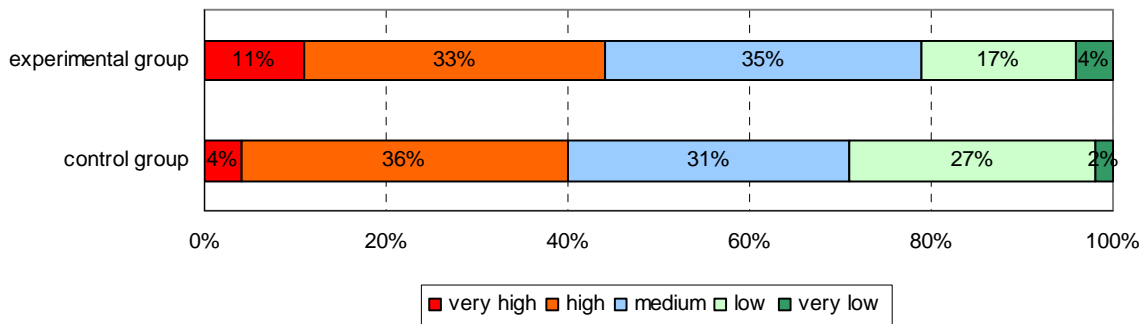
Most tenants in social housing in Angers feel fairly or very well informed about environmental issues in general. Bigger knowledge gaps can be found concerning the consumption of energy and the possibilities of saving energy in their flats. Referring to this more than one third felt (fairly) badly informed.

**Figure 22: How informed do you feel about...?**



About 40 % of tenants think that their consumption in space and water heating or other uses is high or very high - current energy consumption was to be estimated by the tenants themselves.

**Figure 23: Behaviour pattern, mean values**



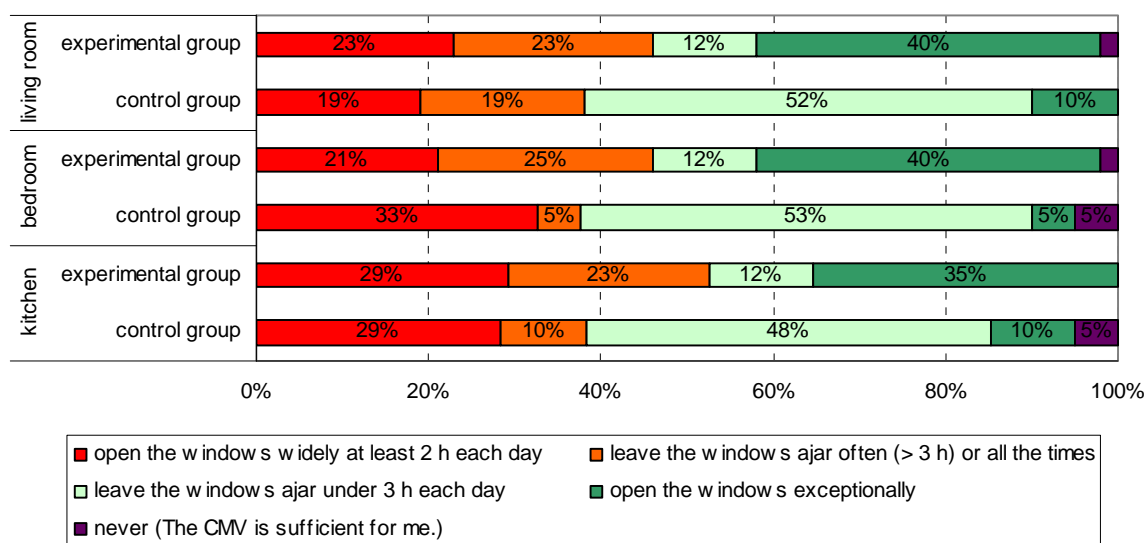
Question: Do you think that your today energy consumption (space and water heating, other uses) is...?

In this context the room temperature<sup>3</sup> tenants feel comfortable with is of interest. In those cases where the tenants cannot regulate the room temperature easily, they more often feel uncomfortable with the temperature in their home. A large majority of tenants with easy regulation options feel comfortable with the room temperature.

With regard to the ventilation behaviour of households having a mechanical ventilation system, the potential for energy saving is obvious. Depending on the use of the various rooms, between 38 % and 52 % of tenants do not ventilate correctly.

<sup>3</sup> Items concerning heating issues "I turn off the heating/the radiator when opening the windows."; "I turn the heating down or off when I leave a room unused."; "I turn the heating down when I leave my home for a longer time." "At night the room temperature is usually low." are missing in this survey because only 5 tenants could regulate the room temperature.

**Figure 24: Ventilation behaviour in winter times or on colder days (households with CMV only)**



Question: If you have a ventilation system: How do you usually ventilate your home in winter time or on colder days? (households with CMV: experimental group n = 48; control group n = 21)

For a number of reasons only little data is available from the final survey of the two groups. In particular, only three of the households in the experimental group, who are using the tenants’ password protected internet portal, took part in the final evaluation survey. A comparison of averages in the experimental group with the control group is of no significance with these numbers.

Some results from the service users are the following: users log in between once a month and several times a week. They report being very interested in water and electricity consumption data and in real-time consumption figures. In addition to that a self-assessment tool is of interest. All the tenants responding are satisfied with the offer of information, the layout and the manageability/ease of use of the tenants’ portal. One household reported being now yet more interested in energy saving and to know more than before about the consumption of energy.

In **Moulins**, housing provider Moulins Habitat in cooperation with specialist service provider Vizelia offered tenants an Energy Awareness Service enabling them to follow their water and energy consumption. The service was provided to 80 flats distributed between the southern area and the centre of Moulins.

The selected flats were equipped with electricity meters dating from the 1970s, which had to be replaced by modern electronic meters. In spite of a framework agreement between Electricité de France, EDF, and Moulins Habitat for the rehabilitation of about 2,000 dwellings, it took over a year of negotiation to achieve agreement on the replacement of the meters in the 80 selected flats. Though energy awareness service operated by Vizelia came into operation before the end of the project, this was not in time for a thorough evaluation. Feedback

from tenants using the service was strongly positive, with the ergonomics of the presentation particularly appreciated.

The inclusion in the online service of feedback on gas consumption for flats equipped with individual heating had not been achieved by the end of the project. Difficulties in negotiations with Gas de France, GDF, were even greater than with EDF. Moulins Habitat finally failed to persuade the GDF telemetering provider to adopt Vizelia technology. Moulins Habitat is now going ahead with Vizelia to introduce additional meters downstream of existing gas meters.

It now seems that problems in negotiations with EDF and GDF may have been due to Vizelia's position in the French energy market. Vizelia had been chosen by Moulins Habitat after an open call for tender to implement energy awareness services for tenants. It was not realised at the time that this choice might endanger timely implementation of the services. Vizelia does not have a strong link to incumbent energy providers and could be seen to compete with their telemetry subsidiaries.

## **Alternative service delivery**

The major alternatives to internet delivery are paper-based services (realised in Berlin and Frankfurt) and service delivery by housing staff (Belfast). The evaluation of the consumption of the tenants who received their information by letter in Berlin and Frankfurt is reported above in the context of the Tenant Energy Portal.

At Nassauische Heimstätte and Stadt und Land most of the service users used the monthly delivered pamphlet which is very similar to the layout of the tenant portal. In general they were satisfied with the offered information. Accordingly the highest satisfaction was with the clarity and illustration of the provided consumption data. Tenants often now know more about the consumption of energy and the possibilities of saving energy in their flats. By using the offered service the tenants primarily were interested in tips for energy saving behaviour.

Over 150 tenants in Belfast completed the Self Assessment Tool via housing staff delivering a PDA-based service.

The Northern Ireland Housing Executive was not able to measure any change in the consumption data from these tenants, because at the time no way had been found for the Housing Executive to obtain the consumption data gathered by the gas utility.

Northern Ireland Housing Executive also provided advice to tenants delivered by housing staff in the tenant home. In the initial survey of 100 mainly elderly tenants in Belfast, 38 stated that they were not quite sure how to use their heating controls effectively. As part of the project this group were offered advice by trained energy advisers. Of the 38 tenants contacted, the 33 that were still resident at the same address at the end of 2007 were given more detailed advice and training in the use of controls.

In order to evaluate an impact on gas consumption, the Housing Executive again contacted Phoenix Gas, requesting gas consumption data for 2007 and 2008 for the 25 tenants who used this fuel (the other 8 used oil). Following advice on data protection, Phoenix supplied the records without names and addresses, so that figures for individual tenants could not be identified. Out of the 25 records

supplied, only 12 satisfactorily covered the period of the project. The records for 9 out of these 12 tenants showed they used less gas in 2008 after receiving more in-depth advice compared to 2007.

In Northern Ireland most of the tenants were satisfied with the service provided. After the more-in-depth advice they felt (very) well informed about the use of the heating system and the heating controls. Respondents to the retrospective survey described to a lesser extent knowledge gaps concerning the consumption of energy and the possibilities of saving energy in their homes. Predominantly they did not notice any topics they need to know more about in order to save energy.

## Other lessons learnt

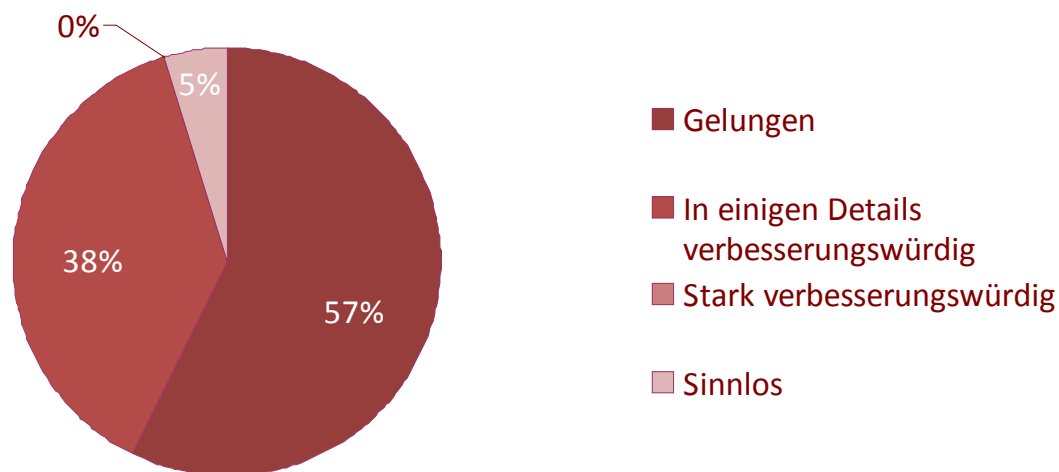
### Initial feedback on the Self Assessment Tool

During the development phase, STADT UND LAND evaluated the effectiveness of the Self Assessment Tool (SAT) with its own employees. Many employees of STADT UND LAND are particularly aware of environment issues, not least because the company has achieved EMAS certification.

The SAT was implemented on the internal portal of STADT UND LAND. Results were obtained from 20 percent of the employees who answered a questionnaire and commented on the tool.

Figure 25: Response of employees to the SAT quiz – Berlin

#### Wie bewerten Sie dieses Energie-Quiz?



57 % of employees found the SAT worked well without any need for change. 38 % felt that some changes should be made. None rated the SAT "useless" though 5% did rate the tool as in need of major change. The most frequent change proposed by employees was an improvement in the vocabulary used in the tool - the language should be simpler and some issues better explained.

Comments and suggestions by STADT UND LAND employees were taken into account for the final version of the SAT deployed on the company's tenant internet portal. Specific information from the evaluation of tenant use of the SAT is provided above.

## **Changes in ventilation behaviour**

Concerning potential changes in consumption behaviour, it could be observed that the tenants often improved their ventilation behaviour in winter time or on colder days. In before-after-comparison now most of the respondents ventilated their homes by opening the windows widely at times. In addition to that they optimised the temperature choice in winter time, in little used rooms the temperatures were clearly lower than in much used rooms.

In Berlin the comparison between experimental and control group showed that the ventilation behaviour of the experimental group was ideal. Furthermore they acted more environmentally friendly in heating and electricity consumption and attached more importance to the separating of the household waste than the control group.

## **Savings by kind of service**

During the evaluation of the project, we have gathered considerable amounts of information from the pilot sites to evaluate the success of the various energy awareness raising strategies and techniques implemented by the partners.

It was decided to focus on the analysis of tenant behaviour by tenant surveys before introduction of services and during their use. It has been possible to analyse energy heating consumption, e.g. in Karlsruhe and with the data provided month by month over a long period, it was also possible to analyse cold and hot water consumption, e.g. in Berlin.

In Frankfurt, space heating and hot water consumption are measured with a single device, not allowing the data to be split. The two French platforms, with the difficulties of implementation of the measurement system, started late in the last heating season and it is hard to identify a consumption patterns over this short period. All sites plan to continue to analyse consumption over longer periods, to see if the behaviour changes persist.

Consumption behaviour and data was subject to a number of influences apart from provision of the new services:

- varying energy tariffs
- the 2007/2008 financial crisis
- unusual weather - 2007 was very warm, 2008 closer to average, January 2009 very cold
- data from some operators inaccurate / contains estimates
- variation in the number of occupants per dwelling, tenant change, births, deaths, long absence etc.

Comparison with control groups will have reduced the impact of these extraneous factors, but numbers are small in many cases.

From results from German sites in particular, our best estimate is that with present service design, space heating savings could be about 9% and savings in water consumption around 5%. It has to be cautioned that the numbers involved are low. It should also be pointed out that a reduction in saving may be underestimated given that control groups were also surveyed and set many questions about their energy behaviour and attitudes.

## Summary of lessons learnt and recommendations

Helping tenants optimise their energy-related behaviour is essential if significant energy savings are to be achieved in European social housing. Information gained in the SAVE@Work4Homes project confirmed that the potential for energy saving is very large: many tenants appear to be largely unaware of ways in which they may be wasting heat delivered to the home. Consumption-based billing is only a help in combating waste or reinforcing energy-saving action by tenants when there is little delay between a change in behaviour and the change in a bill. This is not widespread practice today. Consumption based billing for heating in Germany is annual, and many energy utilities continue to read meters irregularly and at long intervals.

Given this lack of appropriate feedback, even tenants whose awareness of environmental and energy issues is high have great difficulty in translating their intentions into appropriate action. Tenants surveyed consider that social housing companies could help by giving them more accurate information about their consumption and advice on how to reduce it

Services and tools developed in SAVE@Work4Homes promised to assist tenants in adapting their behaviour to more efficient use of energy, and to some extent this promise was realised. The evaluation process demonstrated that savings goals can be achieved, e.g. saving of heating energy in the case of Karlsruhe with a rate of close to 10% or in Berlin the water saving of tenants in the experimental group was 7% higher than in the control group. It should be noted that in some cases numbers are small, and that not all extraneous influences will have been cancelled out by the use of control groups in the evaluation.

Another result asks for more long term evaluations: Energy consumption is routine behaviour, which - learnt once – takes place mostly unconsciously. In order to achieve behavioural changes first of all tenants need to be aware of their habitual behaviour patterns. Only afterwards a new learning process can be started, supported by the offered Energy Awareness Services. In doing so, the target change of mindset includes two preconditions – a fairly long habituation time and enough motivation on the part of the tenants. The last-mentioned is much easier and successful if economical incentives take effect. From a social psychological point of view the saving-money motivation is much more behaviour-relevant than the environmental awareness, but inefficient by lack of relevant information.

The project showed the importance of relevant information to change the behaviour of tenants with respect to their energy consumption. It remains to further explore the results obtained in the years ahead also by taking account of the huge development in this area. By doing so, and by increasing the effort to maintain support for tenants, they will persist in their desire to change their habits to save energy.