SAVE@Work4Homes

Supporting European Housing Tenants
in Optimising Resource Consumption

How to implement Energy Awareness Services for European social housing tenants?

Methodological guide for social housing companies developed by SAVE@Work4Homes

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http://save.atwork4homes.eu

Intelligent Energy Europe

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1. INTRODUCTION

For a number of years now, it has been known that the reduction of energy consumption and of other resources like water are major problems that mankind must tackle urgently. The residential and tertiary building sector in Europe accounts for 40% of energy consumption (27% in residential).

This problem is particularly hard to solve in the social housing sector where tenants' incomes are already severely affected by the recent fuel price increases and where the capacity of the tenants to absorb the additional costs of energy efficiency works is very low.
Many solutions exist, but often the costs of improvement works greatly exceed the benefits in terms of reduced operating costs. Some solutions are applicable only on a very small proportion of the stock and their effect will not be visible for many years.

For example, the application of more efficient thermal regulations for new buildings only concerns around 1% of the stock and will have a limited influence on overall energy consumption. In 20 years, a division by a factor 4 of energy consumption in this part of the stock will affect a reduction of only 12.5% on the average of all stock and the economic situation of the tenants living in the old dwellings will not have changed.

In the case of the refurbishment of the existing stock, the investment will be very high (a minimum of 20 k€ per dwelling will be necessary to reduce the energy consumptions by a factor 2: from 160 kWh/m² in the social housing stock which has been partly retrofitted to 80 kWh/m²). Therefore, it is not possible, for many reasons (financial: lack of performing financing, cultural: lack of professionals able to do the work), to treat more than 2% of the stock per annum. 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.

Therefore, one has to consider urgently all measures necessary, in the short term, to enable investment in the entire stock – measures financially acceptable to all parties that will have to contribute to the investment (state, region, local authorities, social housing companies and tenants). One has also to consider that 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 have been fully taken into account by the SAVE@Work4Homes project when a consortium of six social housing companies applied to the European Commission to assist them in bringing new Energy Awareness Services, outlined in this guide, to their tenants.

The consortium @Work4Homes is a group of six housing companies – assisted by some specialists on certain topics - which is regularly working together to develop and evaluate new services for their tenants with the assistance of the European Commission.

In two projects the group has improved accessibility to the Internet for tenants and used it to enhance communication between their staff and tenants, when for example, repairs to a dwelling are required. In the third project, the consortium used ICT to save energy and has obtained assistance from the SAVE programme to do this.

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.

This document describes the approaches encountered in the project SAVE@Work4Homes and explains the motivations of each partner and the reasons and conditions for these different approaches.

1.1 National contexts

1.1.1 German context

German social housing context

With the withdrawal of the German federation out of the promotion of social housing the stock in that sector has decreased permanently. 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.

German regulation 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.

1.1.2 United Kingdom context

United Kingdom social housing 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 NIHE stock.

1.1.3 French 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).

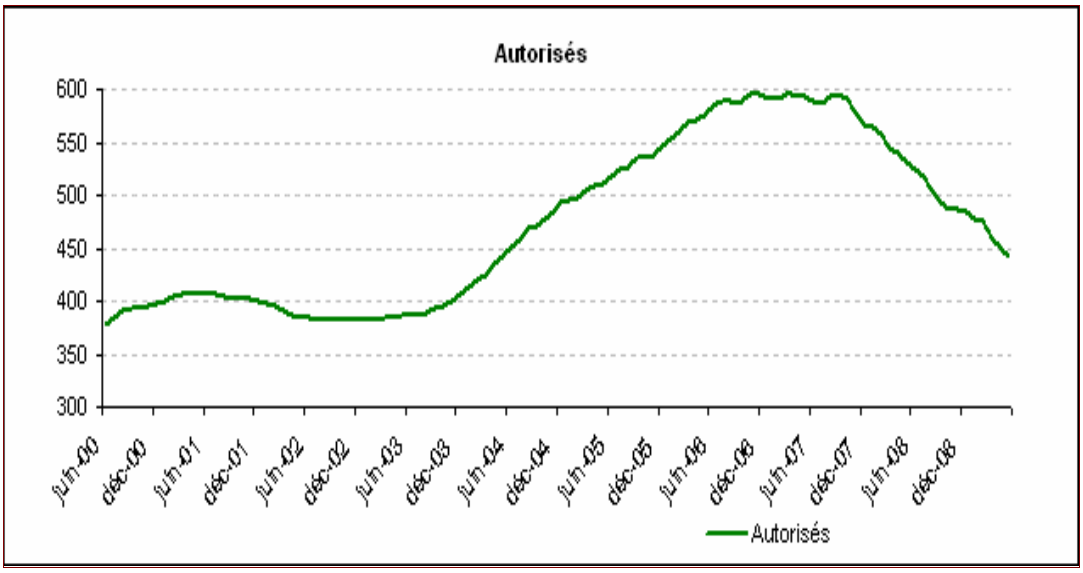


Figure 1: Construction in France (Source: SOeS, Sit@del2 of the French Ministry)

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

French regulation 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.

1.2 The Pilot Sites

Angers platform

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 closed surroundings. 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 consumptions. The other 56% have individual heating systems for which tenants are responsible for paying their bills to the supplier directly.

The company has developed a large program of refurbishment of its housing stock that aims to reinforce building insulation and renew equipment to decrease energy and water consumptions. New European and national regulations relating to energy in housing, have also been applied to our new construction. Certifications such as (Very) High Energy Performance or Passive House are applied for some of our operations. 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 contributes to improve our knowledge in these matters.

There is a necessity to balance on the one hand, the additional costs incurred by the new equipments and the new methods used for construction 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 equipments 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 few 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). But bills and heating charge receipts are not always suitable for providing the 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 we are testing new methods of communications with tenants regarding energy savings. These new methods consist of getting information on electricity and water consumptions as well as information on the temperature of the dwellings directly from the meters and to transpose the data on to a portal. By connecting to this portal with their own login and password, tenants can have regular (daily, weekly, monthly or annual) information on their consumptions and the temperature in their dwelling.

Belfast platform

The NI Housing Executive (NIHE) is the major social housing landlord in Northern Ireland with a housing stock of 93,000 dwellings. As outlined above, unlike many European cities, social housing in Belfast is not based on communally heated blocks of flats/apartments. Instead it is individually heated terraced houses (50%), semi-detached houses (8%), bungalows (22%), and flats (20%). 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.

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, we 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 platform

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 is 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 platform

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 take 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 platform

Volkswohnung (VoWo) was founded in 1922 and is today – as the city-owned privately organized 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 sqm 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^2 in the 1980s to about 140 kWh/m^2 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 us the option 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 our tenants.

The telemetric system necessary to collect the data logged by the metering devices is operated not by a service provider but by Volkswohnung. Data are stored in our general housing data base and evaluated for annual billing of heating costs.

Moulins platform

Moulins Habitat (Moulins), social housing company of the City of Moulins (Allier - 03), manages an estate of about 4 000 flats distributed around the whole of the Moulins's conglomeration. About 50 % of flats use collective heating systems (district heating system and communal boiler rooms). Heating costs are thus directly managed by Moulins Habitat which in turn charges its tenants, including costs relating to regulation, maintenance and energy supply. These monthly expenses are thus updated every year according to variations in the costs of the energy and the consumptions of the tenants. Concerning electricity and gas, the tenants choose their own supplier. That is not the case for the water; indeed, the consumption of water (sanitary warm water and drinking water) is charged by Moulins Habitat to the tenants. The 50 % of dwellings outside the estate of flats are equipped with an individual system of heater (electricity, gas and fuel), the tenants settling directly their expenses to the supplier of energy concerned.

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 participates in the European program SAVE (SAVE@Work4Homes) which aims at developing tools of evaluation and measure to allow the tenants to optimize and to better manage their energy consumptions.

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

1. A communication strategy to the tenants which outlines:
   - The organization 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.
2. 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.
3. 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.

This project joins in a wider process of rehabilitation 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 emphasized the sustainable development by favoring a reduction policy for energy and education of its tenants.

In this context, the south districts of Moulins were thus appointed as main experimental 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 center as they use individual gas heating 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. Later, 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.

2. ENERGY AWARENESS SERVICES FOR THE TENANTS

2.0 Energy Awareness Services planned and implemented

2.0.1 Services planned

This chapter describes the common context and objectives, and also the components used to solve the targeted issues addressing the tenant's energy behaviour. Each service, tool, infrastructure and component developed to deliver these services will be described in detail in chapter 2 and 3.

The approach retained by the SAVE@Work4Homes consortium recognises the great variety of living conditions and cultures in European social housing and does not attempt to define a single best strategy. Instead, the six partners have developed and test a complementary set of viable and effective Energy Awareness Services, based on a "toolbox" of components including:

- 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;
- 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 portals in the Internet;

The means used are:

- notebooks by property managers;
- Internet access by tenants with low-cost WebTV or their own PC or notebook;
- design of print media for tenants such as a handbook for identifying possible changes in building use behaviour of all residents to save energy.

2.0.2 Services implemented

The services developed by the project SAVE@Work4Homes integrate many functions. These functions need the use of tools, infrastructure and components necessary to provide the services. The services could be shared in respect of the scheme drawn below:

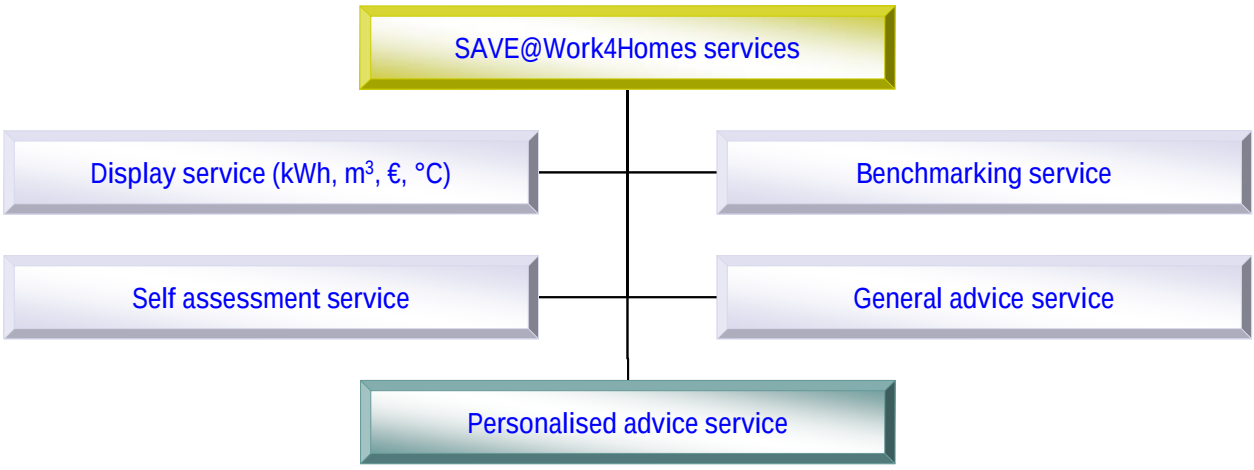


Figure 2: SAVE@Work4Homes services

The services developed by the project SAVE@Work4Homes are provided with the tools described in the next diagram:

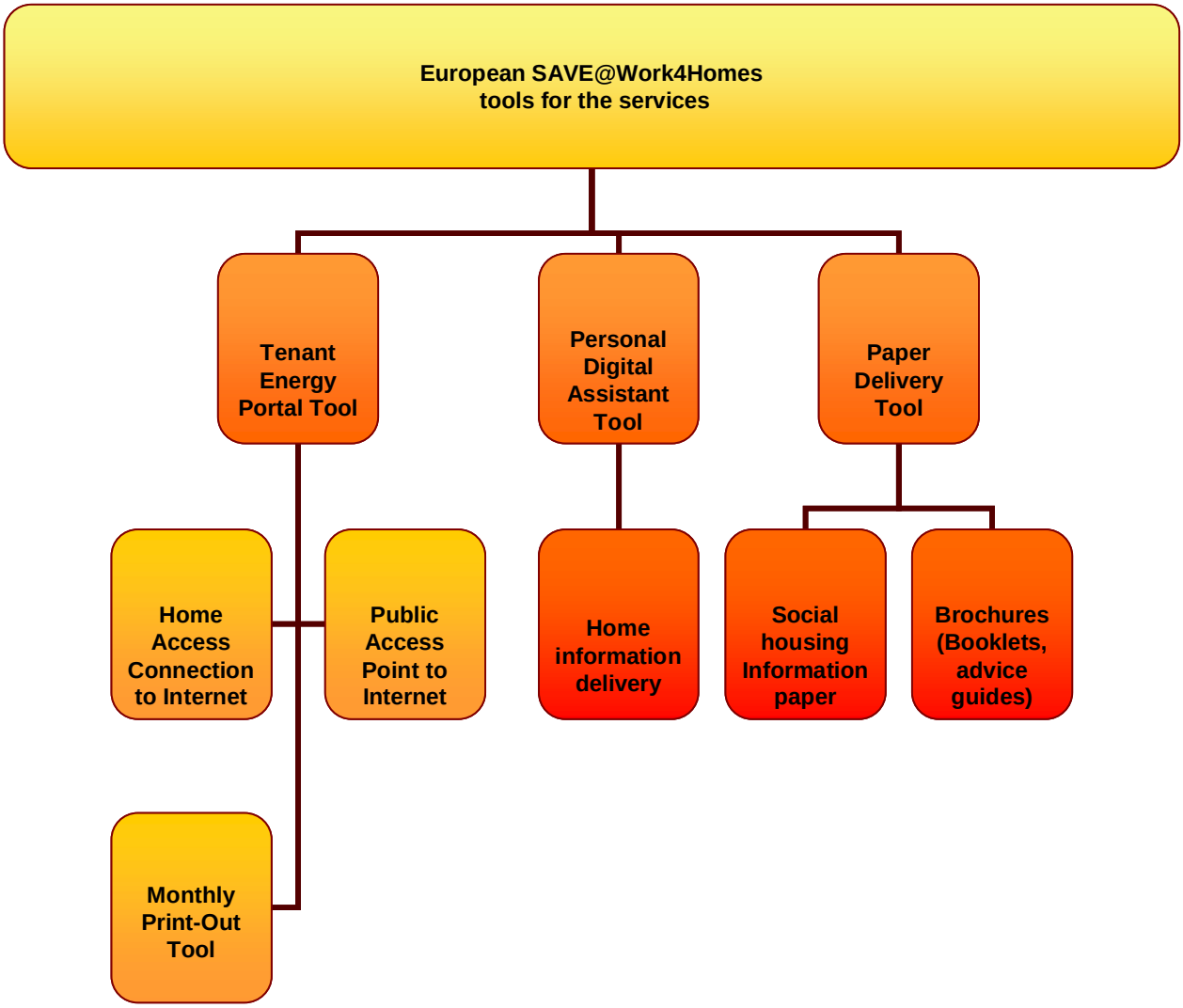


Figure 3: SAVE@Work4Homes tools for the services

Services developed by the project SAVE@Work4Homes need an infrastructure of collection of data defined in the next scheme:

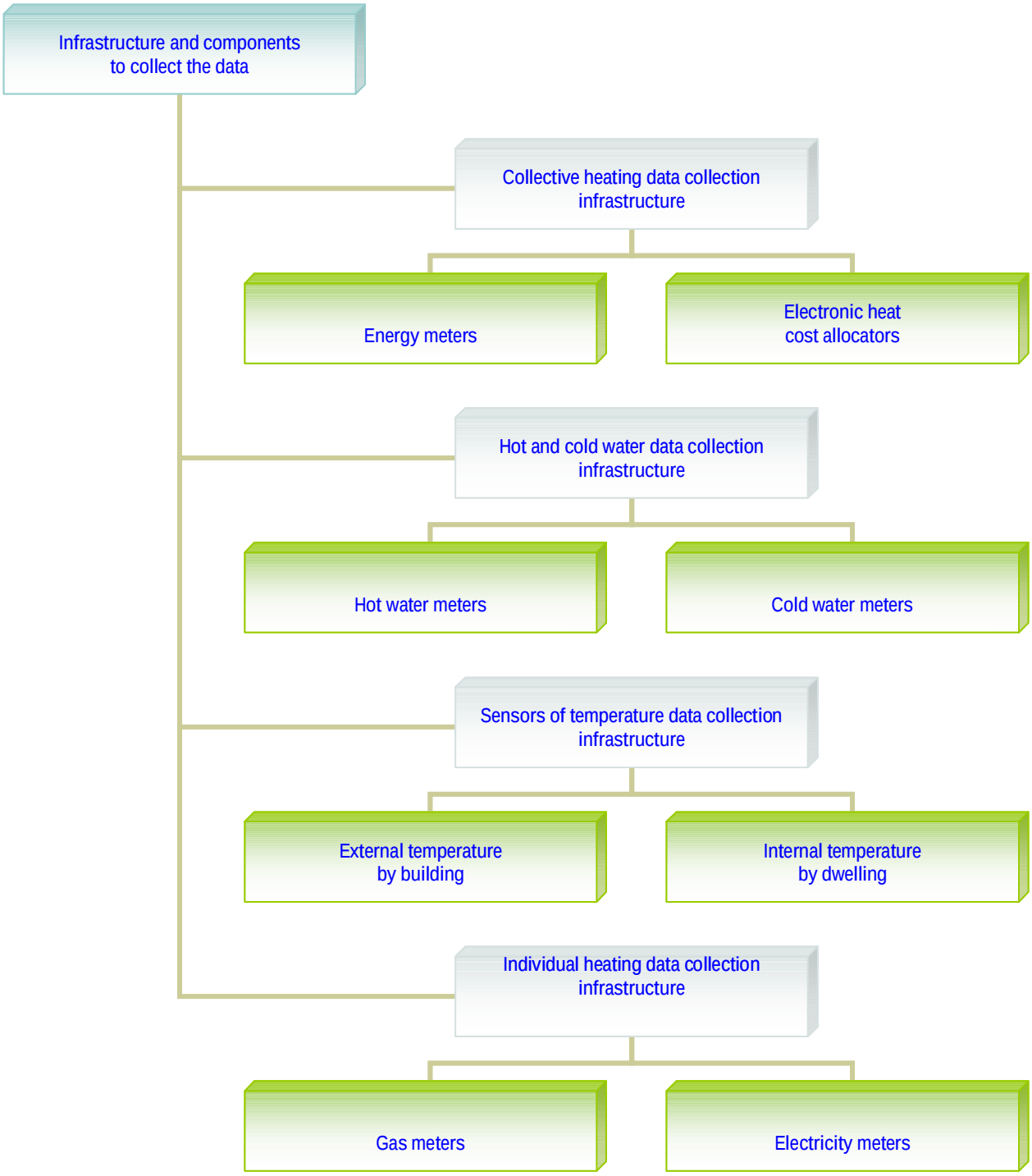


Figure 4: Data collection infrastructure for SAVE@Work4Homes services

Services developed by the project SAVE@Work4Homes need an infrastructure of distribution of information defined in the next scheme:

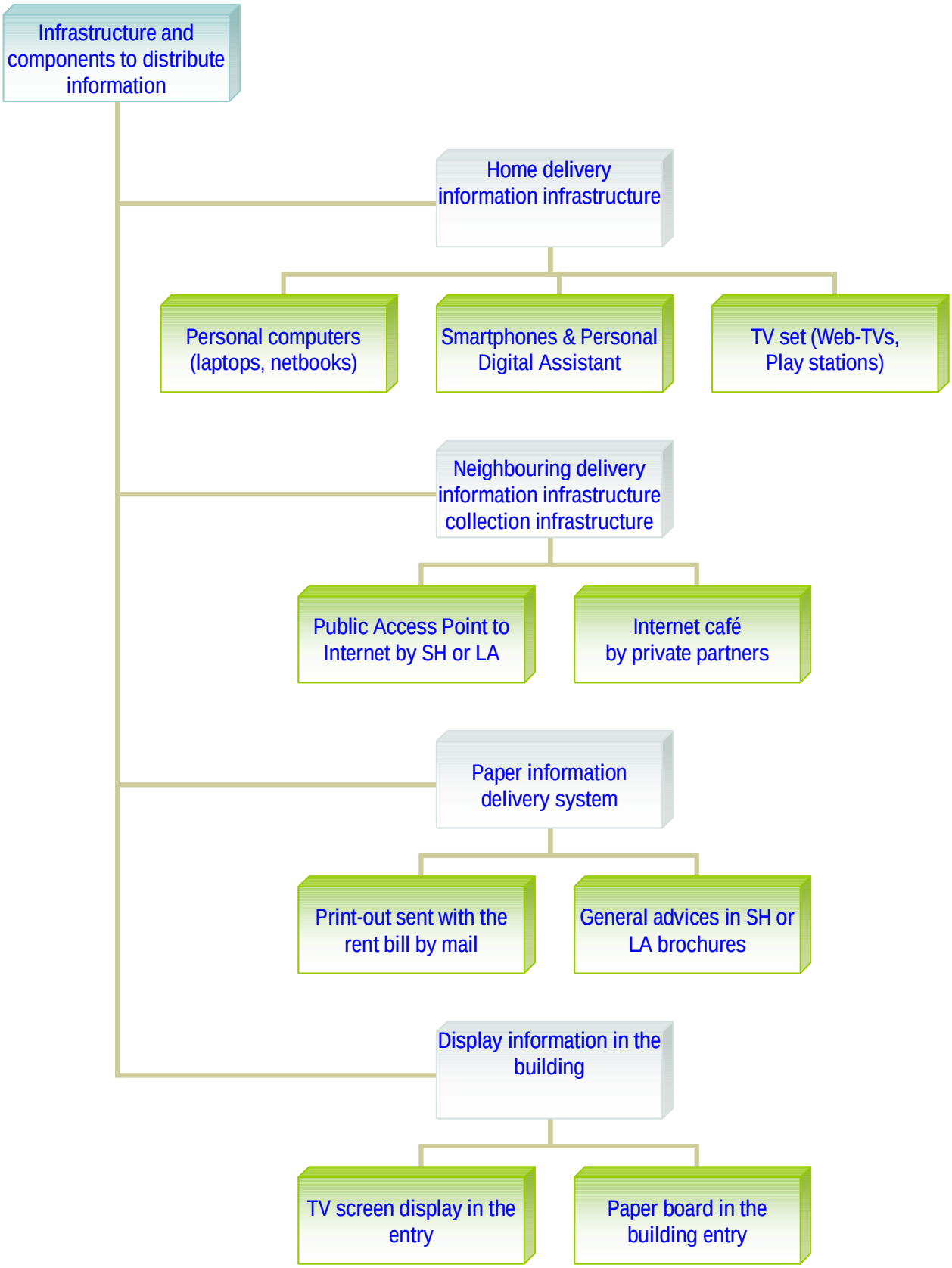


Figure 5: Infrastructure of distribution of information for SAVE@Work4Homes services

2.1 Tenant energy portal tool

The tenant energy portal tool is in the centre of the services and allows the provision of public and personal information to the tenants:

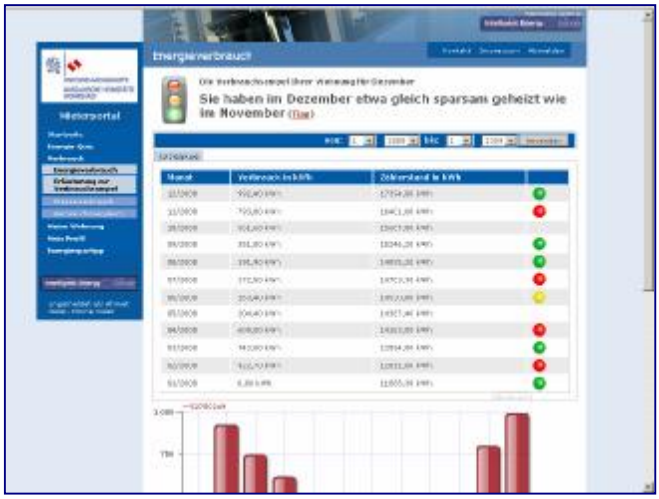
- provision of personal consumption information,
- provision of a benchmarking of the consumption,
- hosting of the self assessment tool,
- provision of general information about good and bad behaviour (advices displayed and brochures downloadable),
- provision of personalised information (messages sent by the social housing staff to improve the tenant behaviour, contractual data of the tenant).

One important option of the portal – unlike the other means of communication – is to provide the consumption data in "nearly real time". Consumption data are presented in graphical and tabular form.

Frankfurt case study

The consumptions are displayed on a monthly basis and comparison with previous months is immediately possible. The annual averages are also shown. To avoid the difference without reference to tenant behaviour, the heating consumptions is calculated in a mathematical algorithm which considers the seasonal differences in heating using degree-days. For an easy understanding by the tenant, a synthesis of the results are presented in a so called "traffic light display" which shows whether the tenant has improved energy consumption or not.

Figure 6: Nassauische Heimstätte portal welcome screen



Traffic light for energy consumptions

Beside this, some contractual data like the rent with its components, the area of the dwelling, contact persons at the social housing company and others are shown.

Figure 7: Tenant portal

Information around saving energy, tenants magazine can be download as well as links to the official website of the social housing company.

A printout function is also implemented for interested tenants who can or will not access via internet the energy data can be printed and send by mail (See 2.4.3 for the details of implementation).

Page of demonstration:

URL: http://tportal.domdata.com

Login: demo - Password: 123456

Berlin case study

The tenant portal has been developed on the same bases with the same partner (DomData).

Figure 8: STADT UND LAND portal welcome screen Print-out page sent monthly with the rent bill

A printout function is implemented for interested tenants who can or will not access via internet. The energy data can be printed and send by mail. (See 2.4.3 for the details of implementation).

Page of demonstration:

URL: http://tportal.domdata.com

Login: demo - Password: 123456

Karlsruhe case study

The tenant energy portal has been developed on the basis of a previous tool implemented during the TRUSTED@Work4Homes project.

Figure 9: Volkswohnung portal welcome screen and synthesis of displayed information

Page of demonstration:

URL: http://www.volkswohnung.com

Login: Volker.Wohnung@VolksWohnung.com - Password: 123456

Angers case study

The tenant energy portal has been adapted on the basis of a previous tool developed by a subsidiary of the French electricity provider EDF, Edelia which had in turn used a company not linked with EDF, Effineo.

It now includes the following services:

- "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),
- "Me comparer": "To compare myself" (benchmarking on 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).

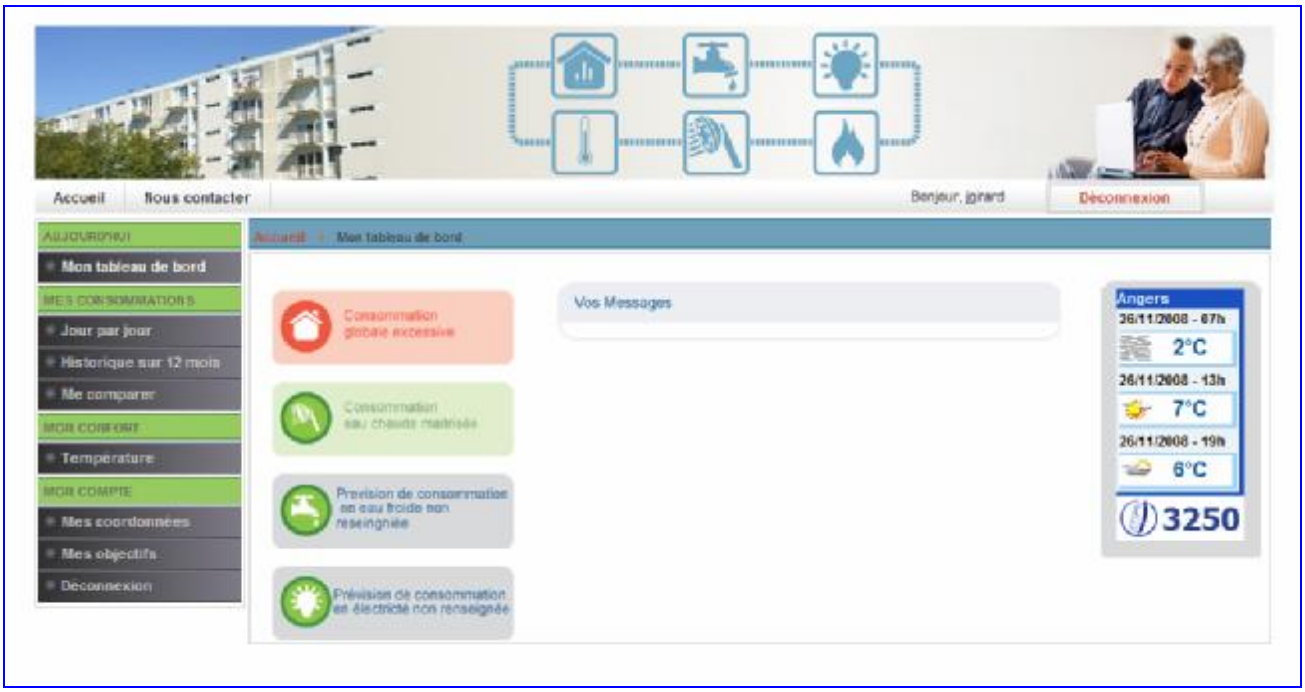


Figure 10: Le Toit Angevin portal welcome screen and synthetic dashboard

Tenants can access the portal with a login and a password through the address of the website www.efficonso.com or through the link which has been included in LTA website www.letoitangevin.com.

This link appears within a specific page dedicated to energy savings including advice on energy awareness behaviours; information on waste treatment and a specific page on energy consumption. A link will also be included to the Energy Performance Certificate of dwellings. Tenants will thus not only have information on their individual consumption, but also know about the energy performance of the buildings. The provider of this project Effineo already had a portal, but LTA asked for some developments and changes, so that the portal can suit their tenants' needs.

Page of demonstration

URL: http://www.efficonso.com

Login: econome - Password: suiviConso.

Or login: gaspille - Password: suiviConso.

Moulins case study

The tenant energy portal has been developed, on the basis of a building tool, by a French software provider, Vizelia.

It includes the following services:

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

The follow-up of the electricity and gas consumptions will be operational in the next few months. Indeed, the project lost some time this year due to negotiations with EDF and GDF.

Figure 11: Moulins Habitat portal welcome screen

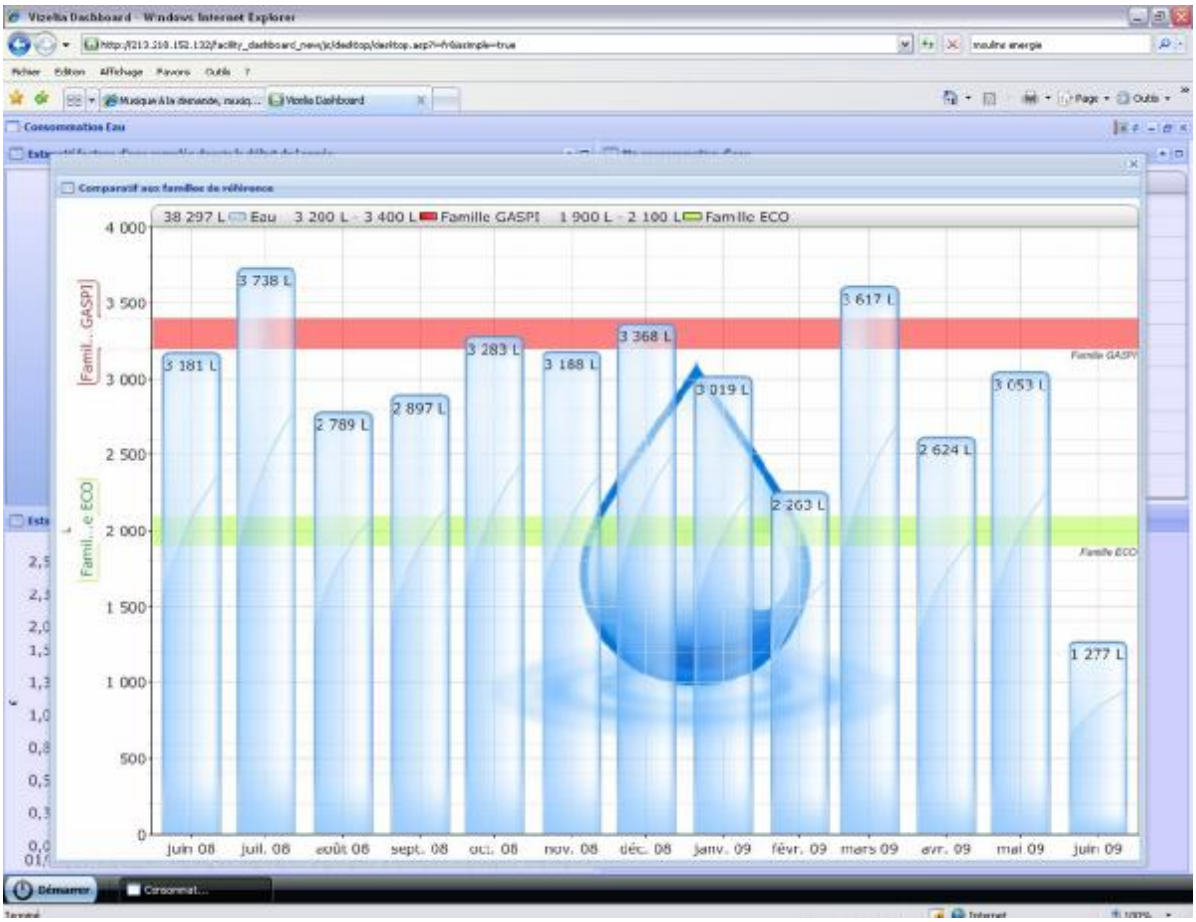


Figure 12: Consumption display and benchmark

Page of demonstration

URL: http://www.moulins-energie.fr

Login: demo1 - Password: demo1

2.2 Self-assessment tool

Self assessment tool (SAT) is an easy to use and manage application. It has been developed by DomData and has (or will) been implemented on all the portal of the site partners.

It is built with PHP and can be run on a web server (Apache, IIS). For end users, it is accessible through web browser. 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.

To use the application the user navigates to a specific website. Then a welcome screen is shown and 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. This gives the user a chance to learn.

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.

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

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 (one set is already available, english version)
- configuration of a specific survey to be shown on a specific page of the website.

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 not an Internet access. It is described in the chapter 2.4.4

2.3 Benchmarking tool

There are two different kinds of benchmarking conceivable. On the one hand a historical feedback of the consumption data is useful. In this case the current consumption data will be compared with the previous consumption data of the same tenant's household. (e. g. Is the current consumption increased, about the same or decreased in comparison with the same month of the previous year. The time periods of the provided data might be quite different. An annual, monthly, weekly or daily consumption figure is possible as well as a real-time data provision. The modality depends on the technical equipment only1.

On the other hand a normative feedback can be used. In this case the tenant's consumption data will be compared with 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) or with thresholds defined by the tenants themselves.

In order to present the consumption data in an understandable and appealing way the data should be put into graphs (for example in bar charts or line charts). Optionally, fixed figures can be used which are created automatically by the software, or the tenants can get the option to create diagrams, charts and the like by themselves. The last-mentioned enables the tenants to decide by themselves which feedback and which kind of presentation they want to see. In Angers the tenants could define monthly consumption limits. These tenants will be warned when the current consumption exceeds the limit values. Nassauische Heimstätte uses a kind of "traffic light" to inform the tenants when their monthly consumption is higher (red), equal (yellow) or less (green) in relation to the previous month.

The benchmarking of energy consumption data requires a specific measurement infrastructure. For metering by flat appropriate meters for heating, (hot and cold) water and electricity are necessary. Either a specific metering company or the housing company itself must be able to read the consumption data. This point is developed in the chapter 3 on the necessary components.

[1] The short data-provision time periods are of course only possible in the internet and not in the paper-based solution. It is obvious that a monthly published brochure cannot provide daily consumption data.

According to the tenants' equipment, the method of data presentation has to be chosen. If the tenants mostly have a personal computer at home with internet access or the housing company is willing to provide the tenants with computer hardware the data can be saved on an internet server. If the tenants do not have the technical equipment in order to get the consumption data digitally on their PCs, the consumption data can be provided with a paper version (for example a brochure).

If the housing company provides a brochure as well as an internet service, the paper version might have a similar structure like the digital version. The different kinds of access to the information are treated in the chapter 2.4.

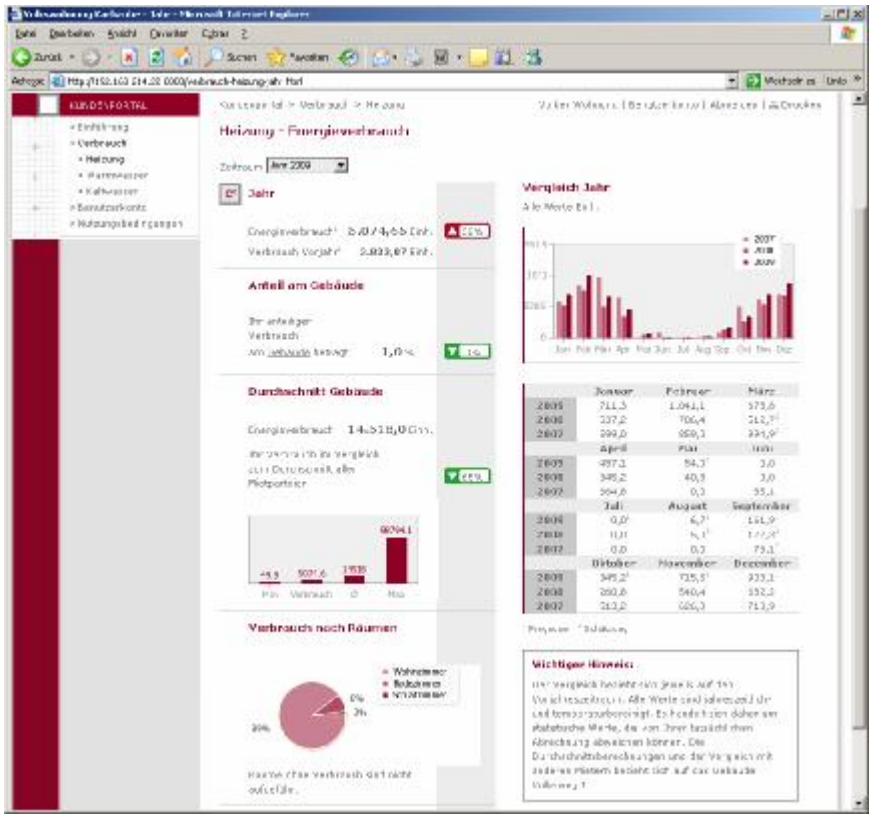


Figure 13: Benchmarking tool

2.4 Access to information services for tenants

For many of the services proposed by the SAVE@Work4Homes project, the tenants must access to the Internet. But, access to the Internet is not only a necessary condition. It is also a means to access to energy information provided by the social housing company or by many other actors at a European, national, regional or local level.

The numerous energy information, campaigns or advices provided by Internet will certainly permit the tenants to enhance their behaviour (like the project SERENADE [http://www.energy-advice.org/] supported by the European Commission or like the websites of the Energy agencies - like ADEME or of Energy providers - like EDF, EON,…).

Provision of home access

Further to the collection and processing of all the data so collected, the tenants can access, via an Internet portal (with an individual login and password), all their consumption details. The internet access will depend on a communication network provided by ICT operators or by the social housing provider when he considers necessary to accelerate the penetration rate of the Internet by the tenants (fight against the digital divide in Moulins and Angers). However, the network is not sufficient. The tenants have to be equipped with PC or others tools. In this context, social housing companies may choose to provide some of ITS tenants, with new or recycled computers or work with a social enterprise company to provide them.

Moulins case study

The internet access will depend on the existing network Web-TV. This network was developed during the @Work4Homes project. The terminal was also provided freely to the tenants by Moulins Habitat (Netbox connected to the Web-TV network and using the TV set as display screen). The first tests allowed putting in evidence the obsolete character of Netbox which supplied to the tenants a free access in to the intranet network set up within the framework of Web-TV. Looking forward to the modernization of the network and the implementation of the future PLC infrastructure, the use of the network Web-TV lives possible thanks a modem provided by Moulins Habitat.

However, a problem remains. Indeed, settles then the ownership of computer tools by the tenants occupying the concerned flats. In this context, Moulins Habitat undertook to give to some of his tenants certain number of computers and works at present on the implementation of a company of social insertion to create a field of recycling of computers and propose so to his tenants of the 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 of the project have developed their own public access point to facilitate the training of their tenants in the use of the.

Moulins case study

For tenants without internet access, Moulins Habitat will install in his the head office a computer with a free access to the Moulins Habitat website and to the Vizelia internet portal (follow-up of energy consumption). Furthermore, their tenants have got a free access in the existing public access point (Cyberbase) of the district of Moulins managed by Moulins Habitat.

Paper-based communication

Paper-based communication is another option for reaching tenants that don't have internet access. It is suited for those tenants whose offline-behaviour is not just a consequence of missing IT-equipment but who reject modern communication technology at all. This attitude can be found among people with a higher age or a lower level of education – both likely to live in social housing.

In this project paper-based communication is not an alternative to the internet portal but an additional service to reach even more tenants. Actually it is technically based on the internet portal using the same database, the same benchmark algorithms and the same presentation techniques.

Berlin case study

STADT UND LAND decided to publish an information letter which could obviously not contain the same detailed information like the internet portal. The content needed to be condensed on one page. So 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 would publish the information letter once a month – the same frequency in which the data on the internet portal is to be updated.

Logged into the STADT UND LAND tenant portal as “Administrator” you can choose the menu item “Print Out”. Here 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 like a page in the tenant portal.

PDA-based services

Belfast case study

Due to the low level of internet access among NIHE tenants, the Housing Executive sought alternative ways of using new technology to bring advice to tenants. One method was through using Personal Digital Assessors (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 NIHE on the use of PDAs generally by Neighbourhood Wardens – this 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.

3. NECESSARY INFRASTRUCTURES AND COMPONENTS TO DELIVER THE SERVICES

The Energy Awareness Services are mainly based on the collection of consumption data. To do it, we have to use or to build a sensors' network assuring the telemetry of all the data relative to the consumptions of water and energy.

In the German case, the network of data collection already exists in many cases. The work consists 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. Sometimes, the data collection is to old or does not fit to 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 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. The communication network used is the mobile network, via a GPRS line in Moulins and a CPL network in Angers. For the water, gas and electricity, the data collection requires the replacement of number of meters incompatible with the chosen technology. Indeed, counters must be electronic and be endowed with electronic pulses to communicate with the set up sensors.

In the United Kingdom case, the heating system is not managed by the landlord. So, the data collection is not possible by the housing company for legal reasons.

3.0 Measuring heating consumption

The heating consumptions can be measured by different methods depending of the modalities of the distribution of heating. In an individual heating, the metering is provided by the energy provider and the billing is made by the energy provider directly towards the tenant. The social housing has generally not access to the consumptions information (see legal chapter 5). In a collective heating, the metering can be made by several means.

Measuring space heating with an energy meter

An energy meter can be used only if the distribution network is correctly organised (horizontal loop inside the flat distributed from one point). But all the distribution networks built before the first oil crisis are not organised like that.

In France, this system has been used some few years after the first oil crisis and later with the system “CIC” promoted by the energy provider “Gaz de France”. It represents under: 1% of the social housing dwellings. The individual heating system has been preferred and represents a considerable part of the new buildings. In Germany, this system is frequently used.

Measuring space heating with an electronic heat cost allocator

When distribution network is organized vertically (the same pipe go through all the flats from the first to the last level of the building), the only solution is to measure the radiator emission with a heat cost allocator. The first generation of heat cost allocators were based on the evaporation of a liquid and they cannot be used to collect automatically the consumption data. They must be replaced by a new electronic generation 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 not at all been used except in the Alsace region.

Measuring space heating with a temperature meter

If the previous are generally used for billing the tenants the energy consumed, the temperature meter is not planned to bill the tenants, but it is able to detect the good working of the monitoring of the heating system or the behaviour of the tenants. As the two first systems are not possible for a reasonable price, in France, this solution has been used to provide accurate information to the tenants to help him to enhance his behaviour – if he thinks that it is good for him or for planet -, and also for the operator of the heating system to enhance the monitoring.

3.1 Measurement infrastructure for collective heating housing

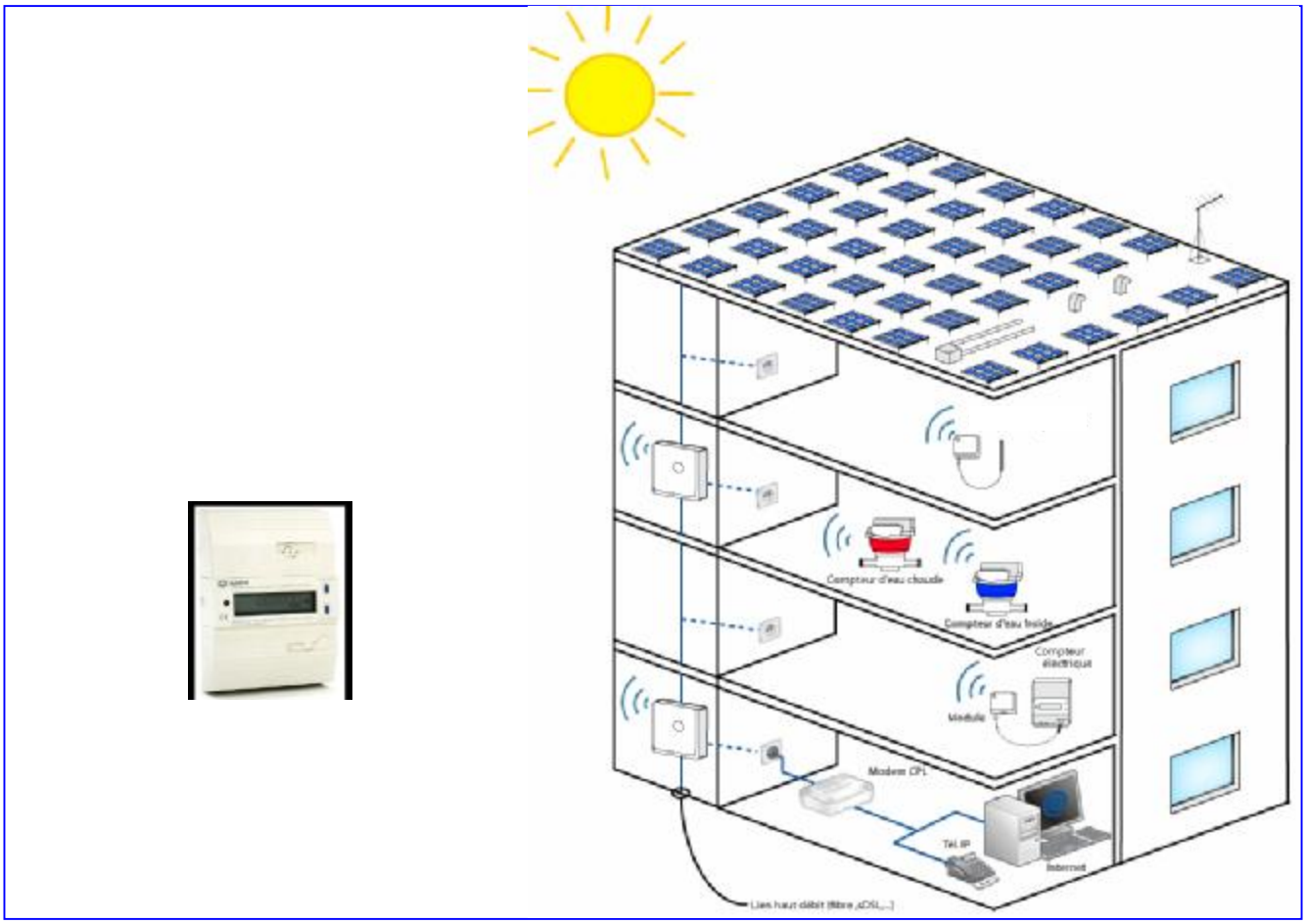


Figure 14: Measurement infrastructure for collective heating housing

Angers case study

In order to make the Energy Awareness Services possible for the tenants, an infrastructure must be implemented. The device developed is composed of the following equipments:

- 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.

Consequently, as presented in the next diagram, the data follows this way:

- the temperature's sensor takes the ambient temperature, transmits it by radio waves to the gateway of collecting data, 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 (witch linked 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.

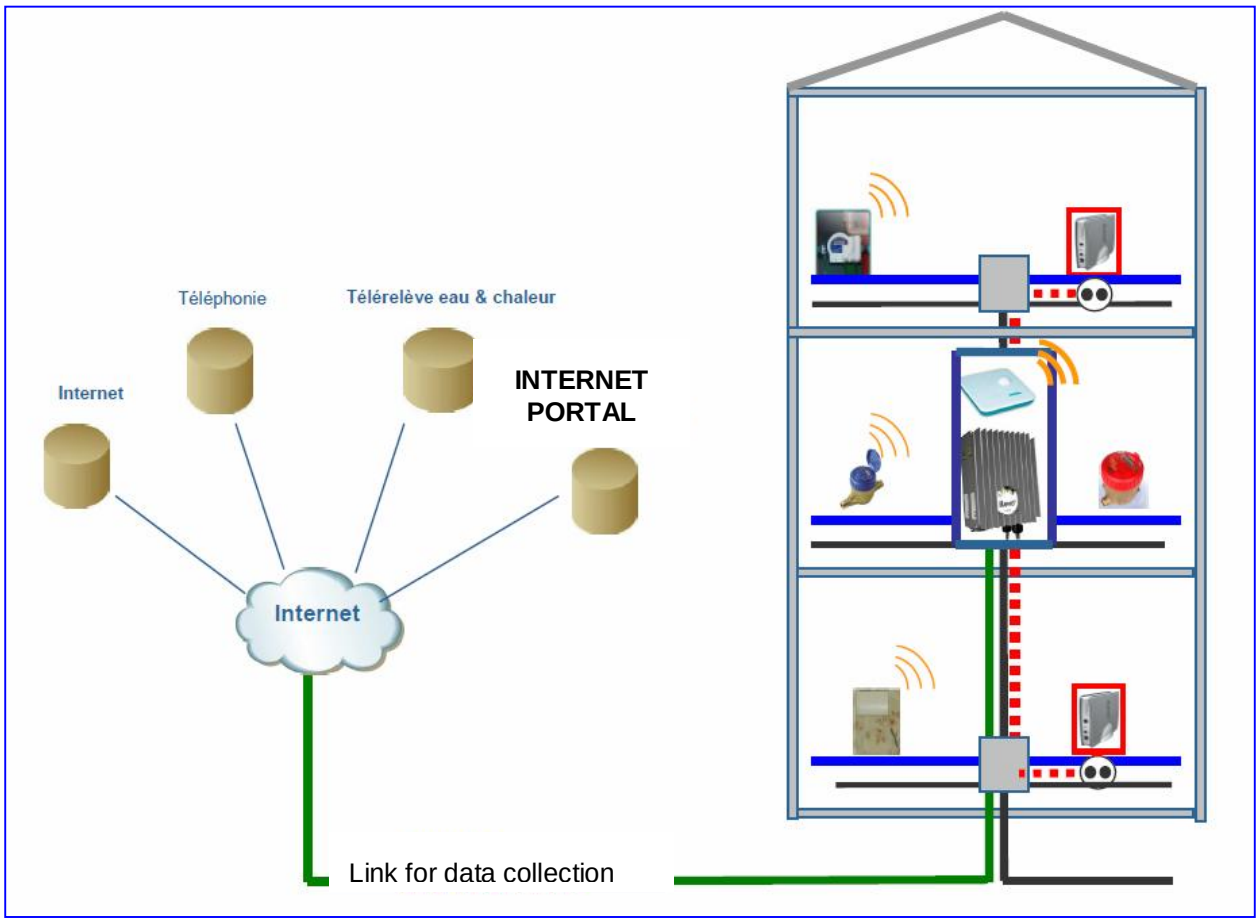


Figure 15: Data collection

This technical choice is justified by the specifics of the site. Indeed, 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 has been 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 developpement of the optical fibre technical functions, lead LTA to prefer other options than PLC.

Moulins case study

This part of the Moulins Habitat project only concerns the south districts of Moulins (Les Champins, Îlot Thonier, Champmilan and Nomazy). 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, as described in the point 2.4, 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)

3.2 Measurement infrastructure in individual heating housing (temperature, energy)

Moulins case study

This part of the project only concern the dwellings located in the down-town of Moulins which 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, we do not have the agreement of GRDF and GDF (French gas provider). So we must install some other 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.

Belfast case study

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

3.3 Measurement infrastructure - Water

Angers case study

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. Indeed, the previous meters were not capable to remote data automatically. What's more, it is necessary to add to the new meters a sensor which ensure the collect of the data and transmit it by radio waves. In order to get the energy awareness service, there was no other solution than to get this new equipment.

Moulins case study

The existing water meter has to be changed by 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.

3.4 Measurement infrastructure – Electricity

Angers case study

To obtain the data on electricity easily, meters have been replaced to be compatible with sensors which have been set thereafter. In 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.

Moulins case study

The system depends on sensors' network assuring the telemetry of all the data relative to the consumptions 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 the 70s 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. The follow-up of the electricity consumption will be operational this summer. Indeed the project was delayed due to the negotiation of the agreement with EDF.

4. COSTS OF SERVICES, TOOLS AND NECESSARY COMPONENTS

4.1 Costs of the tenant energy portal service (TEP)

Frankfurt case study

The investment costs must be surveyed by different aspects. These aspects must contain whether it will be new or already existing equipment or services. The 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€. NH 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.

Karlsruhe case study

To add to this existing consumption measurement system a tenants portal requires:

- 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):

Investment costs	**VoWo (*)**	**external**
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

Operating costs	**VoWo (*)**	**external**
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.

4.2 Costs of providing print-out information service

Besides the additional programming in the development of the tenant portal, there are constant 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).

Berlin and Frankfurt case study

The survey which we conducted among our tenants at the beginning of the project showed that – despite the huge 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 but not an actual part of it. That means that the service is only offered to those tenants where the technical infrastructure has been installed anyway. In the case of our pilot test site the installation costs of the radio metering devices were divided between social housing company and the metering company. In the chart below you can see the planning for the amplification of the technical infrastructure in the next years.

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 options 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).

The Polish software company DomData who runs the internet portal charges depending on the number of users - besides a basic fee of 3.000€ per year and a man day of 500€ per month for the implementation of the 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 usersx0,5 day/month]	888 €	1776 €	3552 €	4440 €	5328 €
Total	10888 €	12276 €	14052 €	15440 €	17328 €
Cost user per year	41 €	23 €	18 €	15 €	13 €

4.3 Costs of the self-assessment tool service (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.

4.4 Costs of the energy and water benchmarking tool service

In general a decision should be made whether the costs of the services shall be shared between the tenants and the housing company or not. The costs 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)

Angers case study

In order to achieve a large participation the costs paid by the tenants shouldn't be too high. In Angers the tenants must pay 2.50 € per month while the housing company has costs in total of approximately 2000 € 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.

Moulins case study

Global financial frame of the project:

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

4.5 Costs of the PDA-based services (NIHE – Belfast)

The 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.

(1) Cost structure of wireless heating and domestic hot water consumption measurement system:

4.6 Costs of the infrastructure of the Internet provision services

Angers case study:

Investment for the internet equipments:

* road works for the optical fibre for 585 flats :	40 k€	68 € / flat
* installation of the optical fibre to connect 12 buildings (585 flats) :	120 k€	205 € / flat
	160 k€	273 € / flat

4.7 Costs of the measurement infrastructure of the collective heating system data collection (CHDC)

Context in Germany

In Germany, the data collection of individual consumptions is a current 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 founded:

1. 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.
2. Evaporation heat cost allocators systems: These systems were implemented in the first stage of the regulation application and are now substituted by the Electronic heat cost allocators. This old system must be replaced by the new one (see the cost below).
3. Electronic heat cost allocators 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.

Context in United Kingdom

There are very few collective heating schemes in the UK and none within NIHE 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.

Context in 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

4.8 Costs of the measurement infrastructure of the individual heating system data collection (IHSDC)

Moulins case study

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.

Belfast case study

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

4.9 Costs of the measurement infrastructure of the water data collection

Angers case study

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 €.

4.10 Costs of the measurement infrastructure of the electricity data collection

Angers case study

Investment necessary for reading the electricity consumption data automatically:

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

Moulins case study

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.

5. TRANSFERABILITY

5.1 Regulatory and legal issues

5.1.1 Personal data protection

Since the directive 95/46/CE publication, the European Union members states have implemented legal dispositions to protect the personal data of their citizens.

As it is possible to deduce some information on the behaviour of tenants with the water or energy consumption data, these data – without contrary legal disposition – could be considered as personal data.

Principles of the personal data protection in Europe

Directive 95/46/CE of the European Parliament and of the council of October 24, 1995, relating to the protection of the physical people with regard of the personal data processing and of freedom of movement of these data concerns the harmonisation of the national clauses so to provide a equivalent protection to all the citizens in European Union.

It applies "to the personal data processing when they are is automated or if the data to which they relate are contained or intended to be contained in a file structured according to specific criteria's relating to the people".

It aims at the individuals "identified or identifiable" and for this reason; the identification of a person can be direct or indirect, in particular from a number or from physical, physiological, psychic, economic, cultural or social criteria. However, legal entities, corporate bodies and so on – who do not have any of these rights - are not concerned.

It does not establish a distinction between the public sector and the private sector.

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

Directive 95/46/CE of October 24, 1995 has an obvious impact on the applications in the project.

The applications of the project are focused upon improving tenant services in ways that may involve personal information on their behaviour – possibly deduced from their consumptions and the time when they are used, so the whole of the process of collection, processing and transmission of personal data must be analysed with care, so it is necessary to study directive 95/46/CE and especially of the national laws taken for its application, and for any additional requirements in national law that are not in the Directive and apply to the protection of personal information or any other sensitive information being processed.

We recall here the binding character of the European directives on Member States to implement their minimum requirements in an appropriate manner in their national law(s). Directive 95/46/CE 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 comparison with the right to a private life, even if each national legislation has to specify the conditions that must be met before processing such data.

Directive 95/46/CE 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, 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 the sanctions. It describes finally the obligations of notification of the personal data processing and the conditions of their simplification on certain limited assumptions.

It entrusts to Member States - the definition of the processing "likely to present particular risks in the eyes of the rights and of freedoms of the concerned people» who are subjected to a principle of preliminary examination.

Directive 95/46 and applications therefore apply to the SAVE@Work4Homes project. Several principles stated in directive 95/46/CE apply to the project of the SAVE@Work4Homes program. The analysis which follows underlines those which are in connection with the SAVE@Work4Homes projects and declines the conditions of their implementation. Obligations resulting either from the directive, or of the national texts already voted by the States Members, or which have to be voted, are included in a table of synthesis. These principles are now briefly enumerated.

Honesty and transparency

Principle of honesty of the collection of information: the processing must relate to adequate, relevant and not be excessive for the purpose of the stated requirement.

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 at ends of commercial canvassing or use by third parties and to the transfer.

Preliminary assent of person

Processing can be carried out only if the person "undoubtedly" gave their assent. Here, assent means a "demonstration of free, specific, and informed will by which the person concerned accepts that personal data relating to him is the subject of a data-processing ".

From this principle, there is possibility of derogation whenever the treatment is "necessary for the conclusion of a contract to which the person is a part" (and, consequently, assent was given by implication). This question requires an examination of national rules which concern the transposition by the Member States.

Confidentiality and safety of the personal data processing

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

- 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 implement technical measures and of organisation suitable to avoid the destruction, the loss, the alteration of the data as well as the unauthorised diffusion or the access, in particular when there is data transmission in a network. To check technical safety and of organisation with respect to the subcontractor.
- To conclude with the possible subcontractor a contract envisaging the respect from the obligations from safety such they exist in the legislation of the Member State.

Nature of the personal data processing and consequences in terms of declaration

Personal data are collected and used by the majority of the partners of the project (management of technical data consumption, detection of behaviour which does not respect the internal temperature allowed by the law…), are for essentially:

- Identity of the tenants,
- Address of the tenants,
- Values of water and energy consumptions
- Temporal profiles of water and energy consumptions.
- Values of internal temperatures.

Taking into account the mainly technical nature of the aims followed by the partners, the majority of the collected data can be regarded as not very sensitive.

By opposition, the principle of banning of the processing of certain personal data is posed by directive 95/46/CE. They are the data which reveal racial or ethnic origin, political opinions, religious or philosophical convictions, trades-union membership, as well as the data processing relating to health and the sexual life.

The use of such sensitive data must result means that one must check the requirements posed by national law, as well as that from the Directive, for their collection, their processing, their diffusion and their preservation.

The processing of these data can, in particular, being subjected to authorisation.

In France:

As an example, 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.

In United Kingdom:

The Data Protection Act of 1998 retains the concept of significant 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.

Principles of Data Protection Act 1998 (England)

There are eight principles put in place by the Data Protection Act 1998 to make sure that your information is handled properly.

They say 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. »

In Germany:

The Federal Data Protection Act of 2001 adopts a similar position.

Important consequences for the project:

Thus, it should be retained as of now that the concerned person can give his explicit assent to the processing of such data. It is advisable to attentively check the national rules posed in the texts of transposition of the directive. The level of safety for these data must appropriate to the 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/CE and national laws:

Site	Applicable Principles Honesty and transparency	Preliminary assent Except National right	Safety : Confidentiality and safety	Sensitive data Except national right	Notification to control authority Except national right
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**

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

Application to the tenant energy portal tool (all sites excepted Belfast)

The tenant portal must be safe and confidential because of the protection of the data privacy the energy consumption data belong to. This is all the more important if the portal contains contractual or bookkeeping data of the tenant's contract. The access to the data always must be secured by a password protected login.

Application to the 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.

Application to the PDA-based tool (Belfast)

There are no legal or regulatory issues around the use of PDAs by the staff of the social housing company to provide information and explain to a tenant how to save energy by a change of his behaviour.

Whilst there were no legal or regulatory issues around the use of PDAs, there were some IT security issues. For this reason, PDAs are no longer being used by NIHE staff on this project.

Application to the provision of collective space heating (Moulins)

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

Application to the provision of individual space heating (Moulins)

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.

So, 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.

Application to the provision of individual electricity consumptions

German case studies

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.

United Kingdom case studies

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.

French case studies

In France, a very few number of tenants has 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).

Angers case study

In Angers, the negotiation has been facilitated by 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.

Application to the provision of water consumptions

The water consumption data could be considered as personal data. Their treatment is relevant of the process of the personal data collection, with a declaration to the CNIL (National commission for liberty and processing).

Angers case study

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).

5.1.2 Heating billing regulation

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

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 than 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/m2 (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 ten-ants. 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.

United Kingdom

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 (see §1.3.2). 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.

France

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.

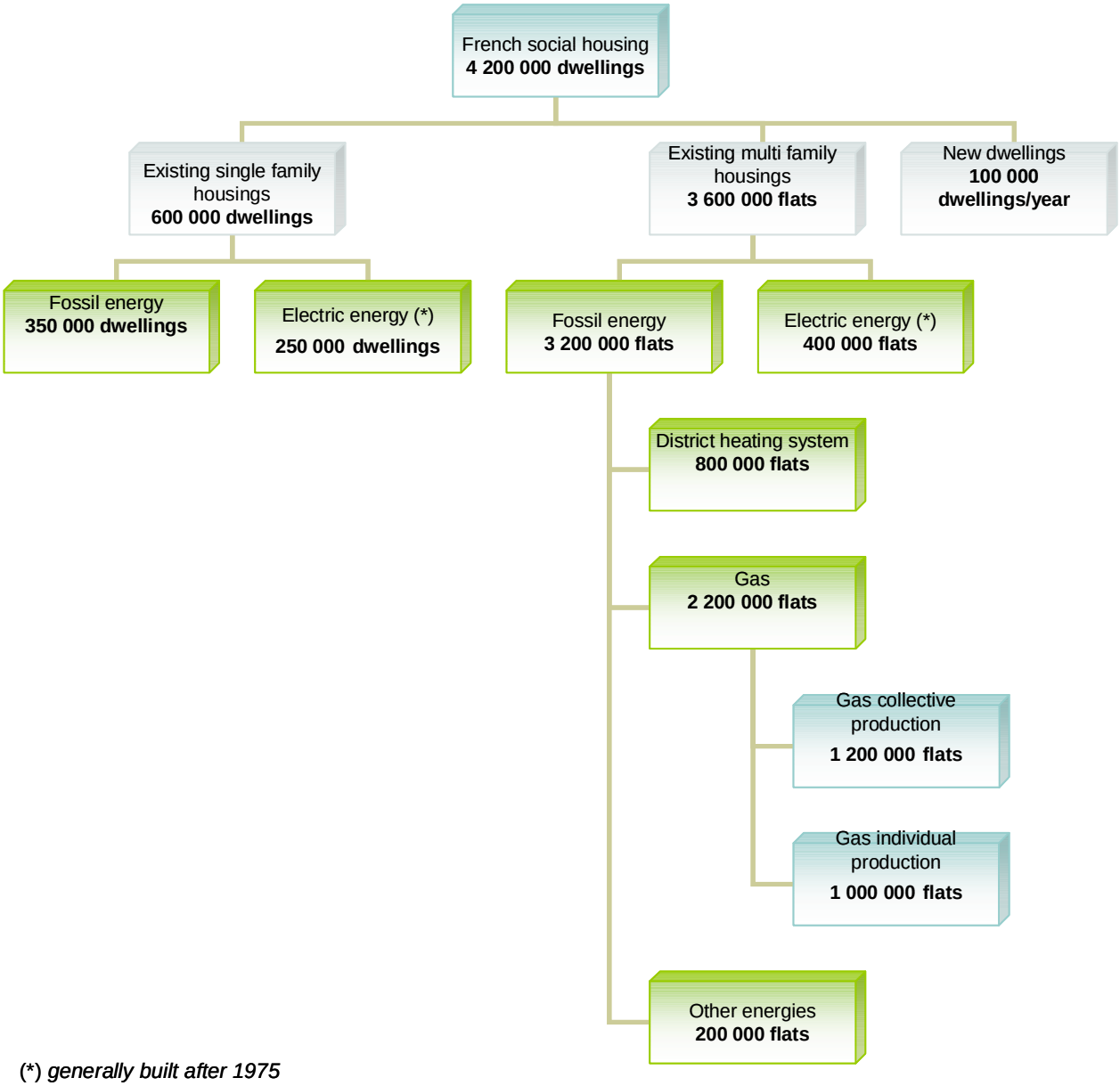


Figure 16: Social housing stock distribution between heating systems and energy used

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.

6. MAIN RESULTS OF THE PROJECT

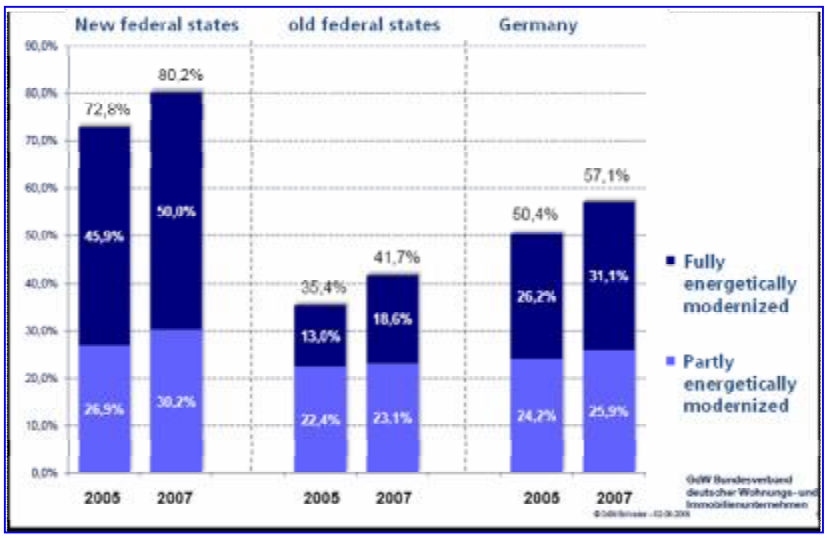
6.0 Energy consumption in European households

6.0.1 Examples of energy saving measures by some countries

Germany (source: GdW)

57% of the German housing stock has been partly or fully modernized in terms of energy systems since 1990. Fully modernized are 31% of the dwellings with envelope insulation, new windows and new heating system respectively boiler. 26% of the dwellings are partially modernized; this means new windows or partial insulation of the envelope or new heating system.

Picture 1 part of energetically fully and partially modernized dwellings since 1990, dwellings in GdW-housing companies.



France (source: USH)

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 CO2 produced by the residential sector.

In 2006, the median energy consumption of the social housing stock (heating + hot water) was 170 kWh/m²/year[2] of primary energy as opposed to 240 kWh/m²/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/m² 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).

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

6.0.2 Examples of energy consumption in 2009

Germany (source: GdW)

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

A part of housing companies stock shows an energy consumption of less than 70 kWh/(m²a) in the whole building stock and has reached the low energy standard for all rented buildings in this way.

As a result the energy consumption for rented dwellings in multi family buildings is approx. 160 kWh/(m²a) in average. This result was given by analysis of energy certificates based on the energy performance of buildings directive.

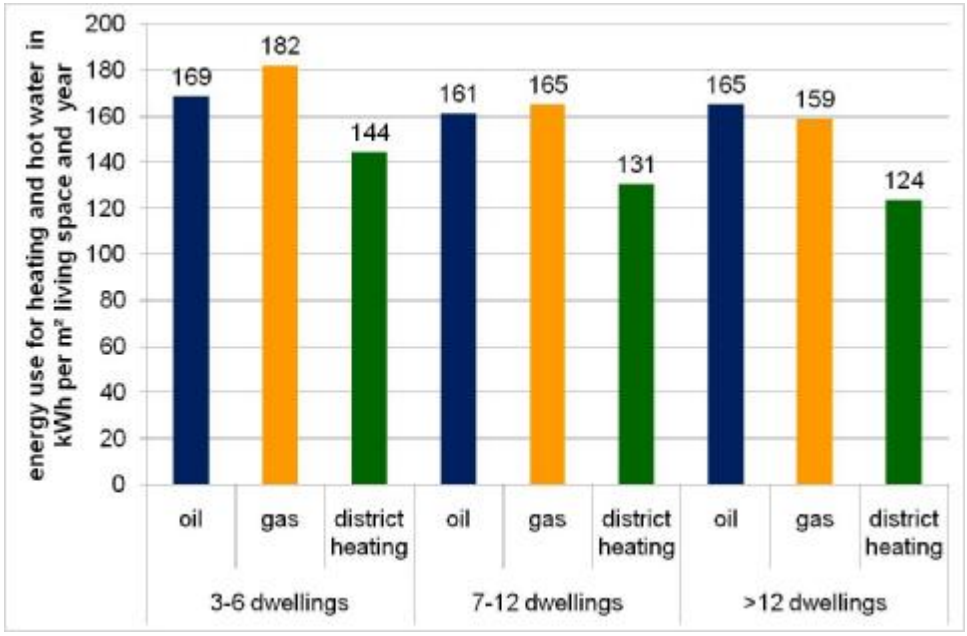
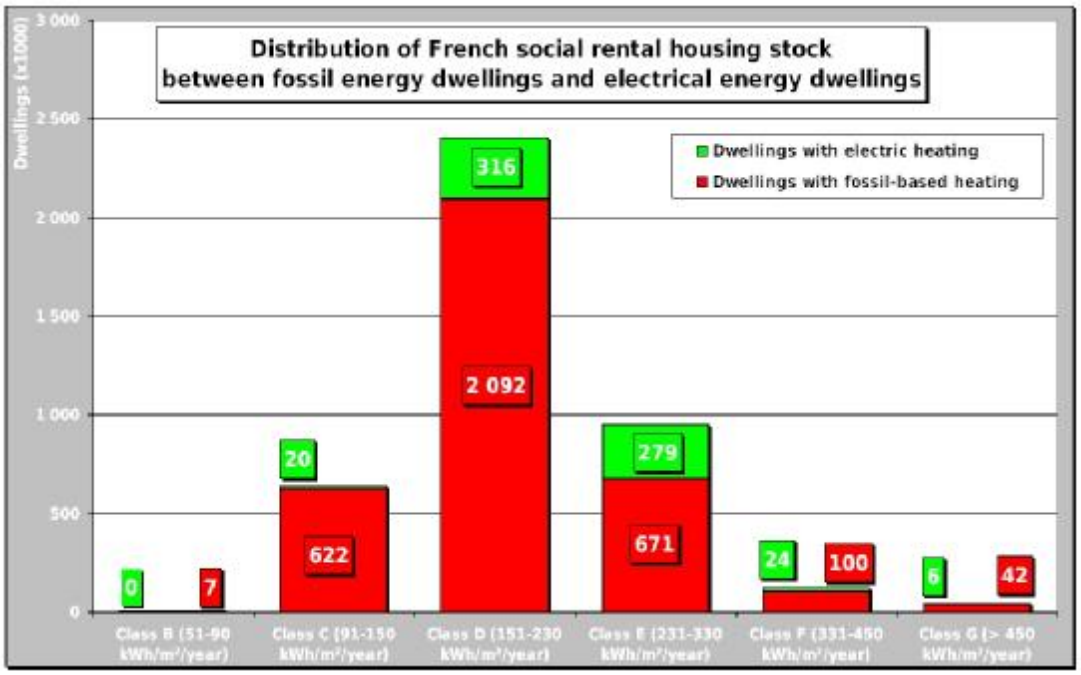


Figure 17: Energy use for heating and hot water

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).

France (source: USH)



Now, three-quarters of the housing stock is classed into B, C and D categories of the energy performance certificate (<230 kWh/m²).

Nevertheless, a quarter of the housing stock remains in classes F, G and H (> 230 kWh/m²).

Figure 18: Fossil energy vs. electrical energy in France

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.

United Kingdom

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

Figure 19: Breakdown of the SAP score by housing tenure

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.

6.1 Efficiency of the tenant portal tool including others tools using Internet

6.1.1 Angers case study

The Le Toit Angevin evaluation approach was designed as a longitudinal study with a control group design. Because of the fact that two comparable survey periods could not be realised, the following data analysis covers a comparison of the experimental and the control group living in similar residential estates. In doing so it must be borne in mind that both groups had the same requirements - at the moment of the survey they did not have any access to an awareness service. While the experimental group got a login subsequently, the control group did not get any information service during the whole pilot project.

Survey results

The experimental group of the initial survey contains in total 50 households. The control group covers 56 tenant households.

	Experimental group		Control group
	Initial survey	**Final survey**	**Final survey only**
Survey period	April 2008	April 2009	April 2009
Initial sample	50	7	56
Final sample	50	3*	56
Response rate	100%	42;8%	100 %
Used method	Directly in flat	By phone	By phone

Figure 20: characteristics of the experimental and the control group

* The final survey included still no tenant who took part in the initial survey. The final survey should be continued.

As figure 21 shows both groups are composed slightly differently only. The experimental group covers more single-person households, the control group more households with children.

		Experimental group	Control group
Gender	Female	44 %	54 %
	Male	56 %	46 %
Average age		43,1 years	45, 7 years
Household size	Single-person household	64 %	34 %
	Two-person household	24 %	18 %
	Three-person household	10 %	16 %
	Multi-person household (four or more persons)	2 %	32 %
Household type	Household with children aged 0 -17 years	14 %	43 %
	Senior household aged 60 and more years	18 %	21 %
	Other adult households without children	68 %	36 %
Income from employment/ self employment		68 %	43 %
Amount of the net household income per month	Below 500 €	8 %	2 %
	Up to 900 €	22 %	15 %
	Up to 1.300 €	38 %	54 %
	Up to 1.500 €	16 %	15 %
	Up to 2.000 €	12 %	6 %
	Up to 2.600 €	4 %	8 %
Permanent access to internet at home		46 %	52 %
Availability of a computer		62 %	79 %

Figure 21: Socio-demographic characteristics of the experimental and the control group

Considering the fact that both compared groups had the same basic conditions the findings are very similar.

Most tenants of both groups 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 in each group felt (fairly) badly informed.

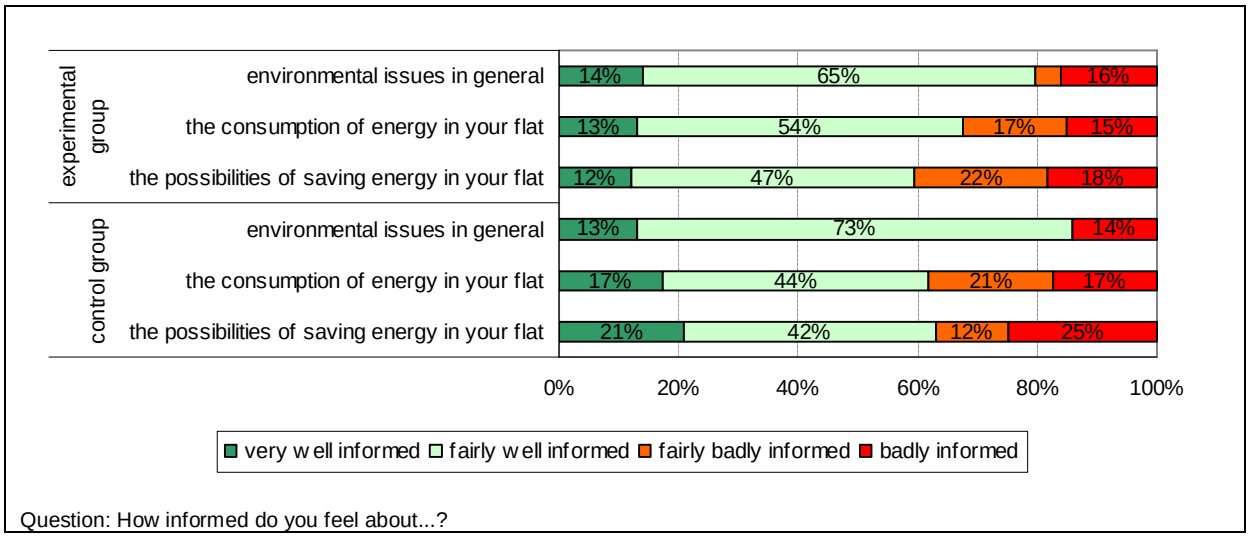


Figure 22: Information about environmental issues

Big similarities between both groups could also be observed with regard to the current energy consumption which should estimated by the tenants themselves. About 40 % think that their consumption in space and water heating or other uses is high or very high.

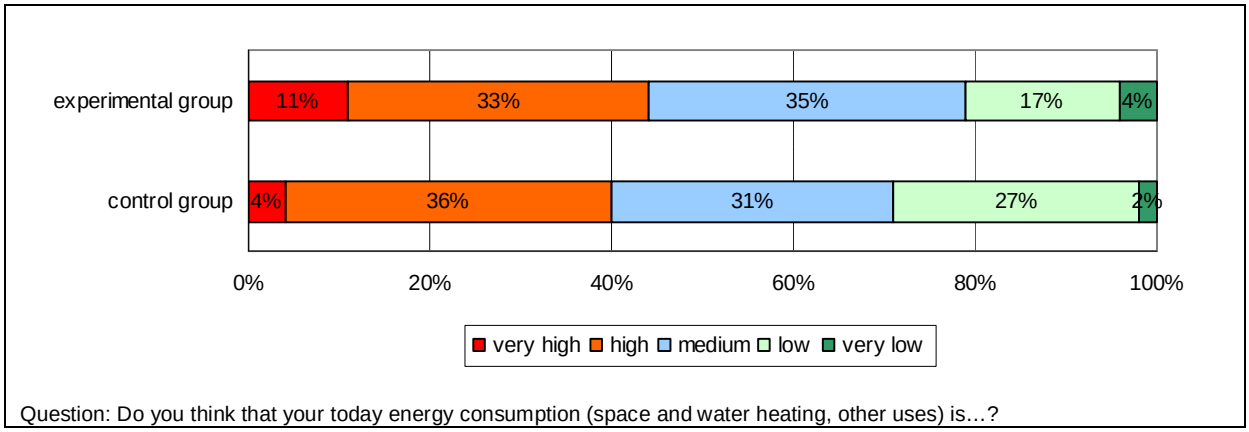
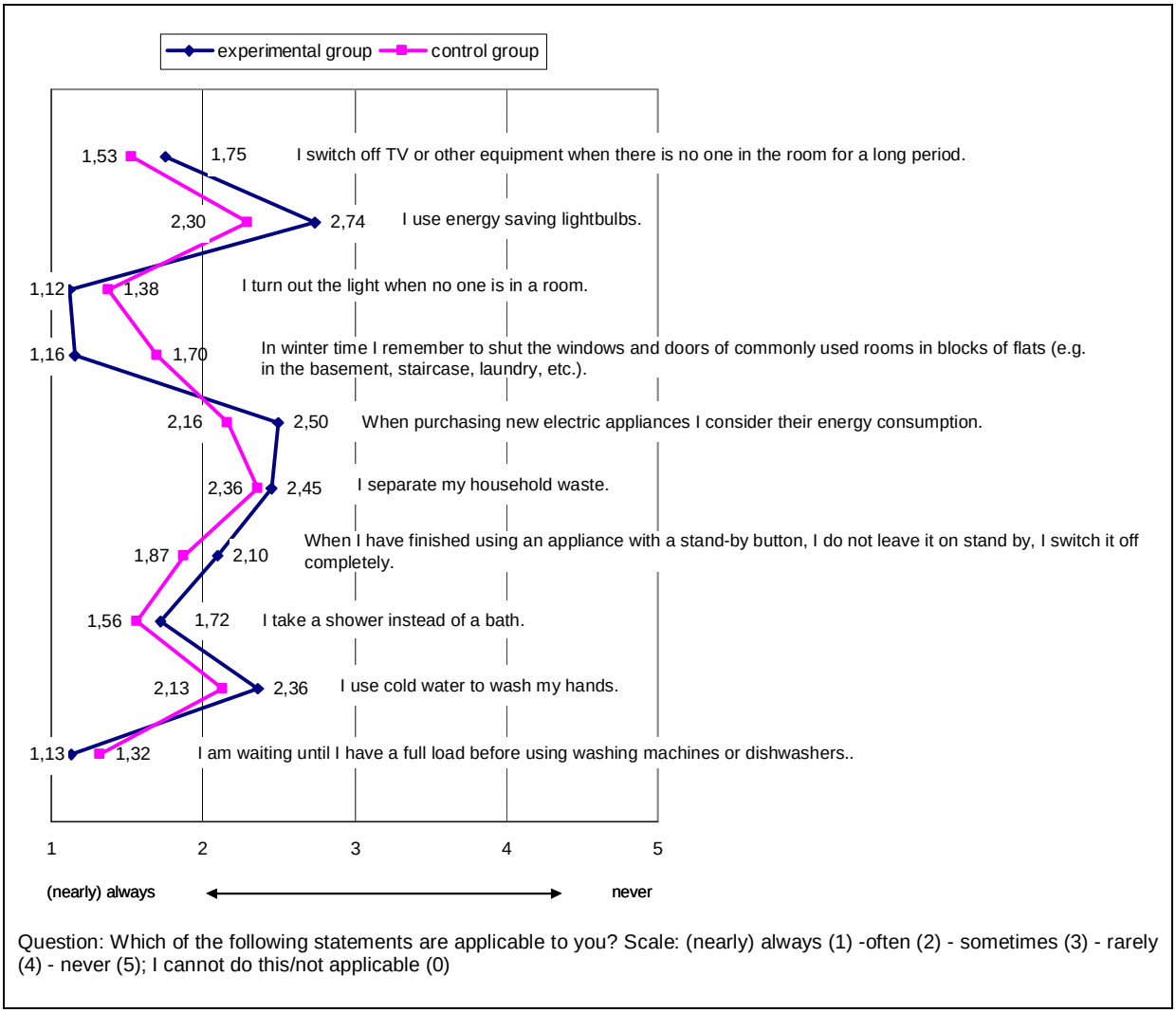


Figure 23: Subjective estimation of the today energy consumption

The everyday behaviour patterns are very similar too. The items concerning the heating issues[3] are missing here because 51 of 56 tenants of the control group cannot regulate the room temperature. The same applies to 24 households of the experimental group.



Question: Which of the following statements are applicable to you? Scale: (nearly) always (1) -often (2) - sometimes (3) - rarely (4) - never (5); I cannot do this/not applicable (0)

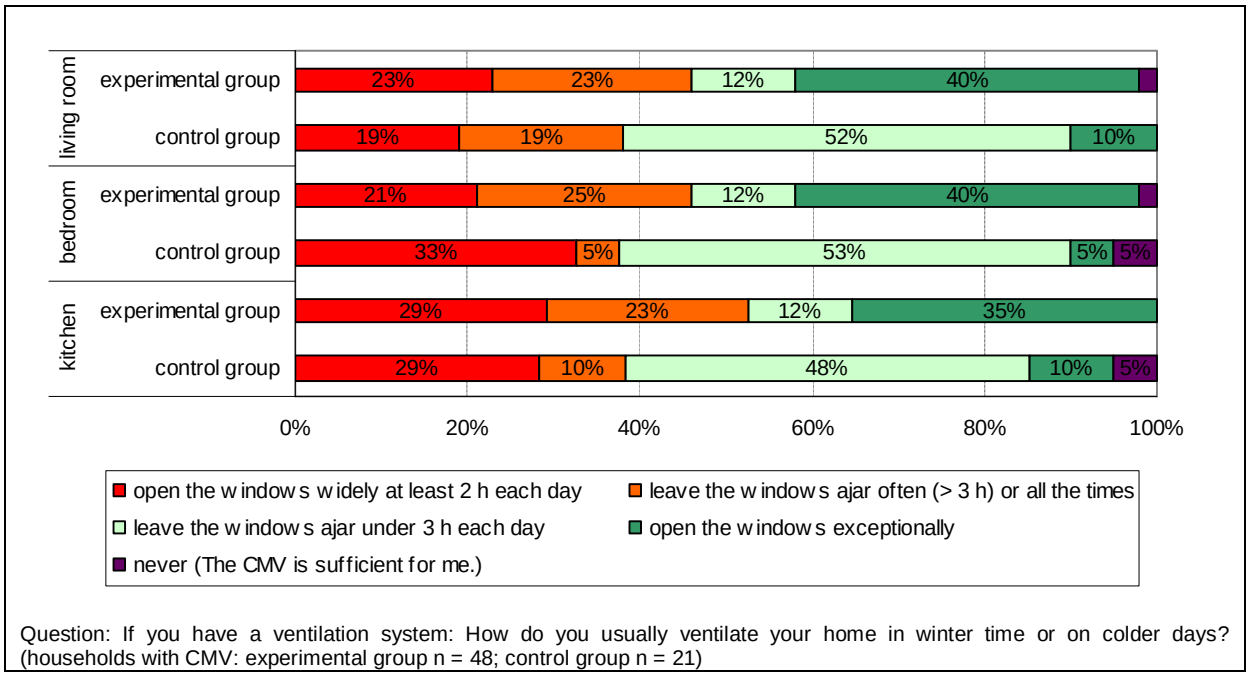
Figure 24: Behaviour pattern, mean values

In this context of interest is the room temperature tenants feel comfortable with. In those cases where the tenants cannot regulate the room temperature easily, they more often feel uncomfortable with the temperatures in their homes. By using the example of the experimental group 77 % of tenants with easy regulation options feel comfortable with the room temperature. In the different case these are only 62 %.

With regard to the ventilation behaviour of households having a mechanical ventilation system - as shown in figure A.6 - a big energy saving potential is obvious. Depending on the use of the various rooms between 38 % and 52 % of the respondent tenants do not ventilate correctly.

[3] "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."

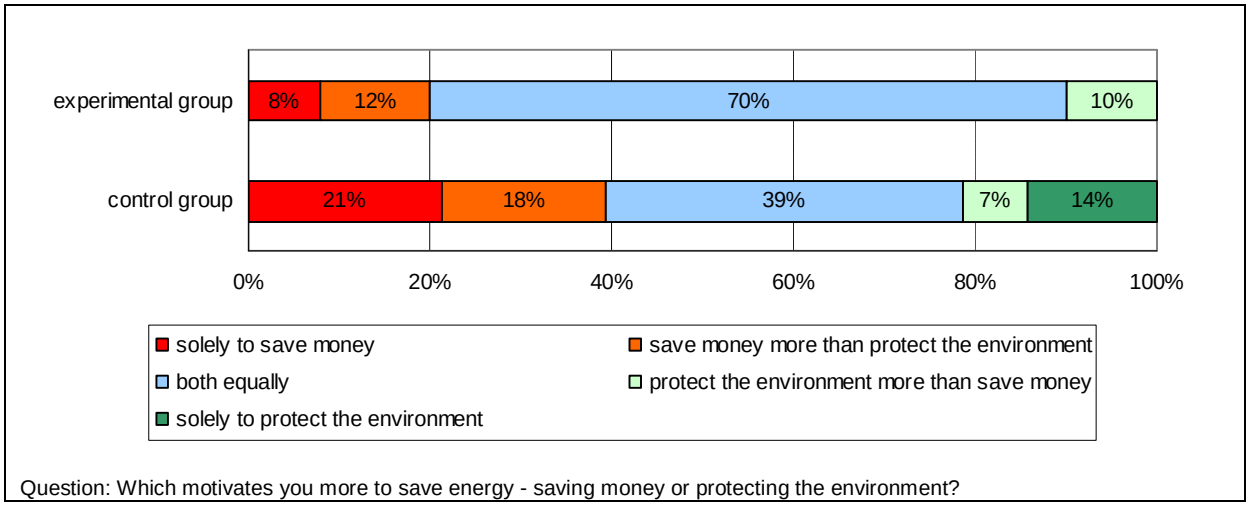
35 households of the control group with no ventilation systems act slightly better: About 25 % leave the windows ajar often or all the times.



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)

Figure 25: Ventilation behaviour in winter times or on colder days (households with CMV only)

Some differences between both groups consist in the motivation to save energy. The control group is much more interested in saving money than the participants of the experimental group.



Question: Which motivates you more to save energy - saving money or protecting the environment?

Figure 26: Motivation to save energy

68 % of the tenants' households of the control group are interested in an awareness service. 52 % already noticed this offer because of a letter from Le Toit Angevin.

As above, mentioned only three households, who are using the tenants' password protected internet portal, took part in the final evaluation survey. Some results:

- They log in between once a month and several times a week.
- They are very much 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 tenants are satisfied with the offer of information, the layout and the manageability/ease of use of the tenants' portal.

- One household is now more interested in energy saving issues and knows a little more than before about the consumption of energy.

6.1.2 Berlin case study

Participation

102 tenants in two different buildings are equipped with a radio metering system – which is the precondition for a participation in the project. All of them were contacted to participate in the test and 13 decided to do so. Thereafter, six tenants decided to receive the information by letter and seven via the new tenant internet portal.

It is not easy to explain why only a few tenants participated in the test as it was an additional cost-free service and we even gave small presents as an incentive to the participants. The survey that we conducted at the beginning of the project among the tenants still showed a high interest in environmental issues in general and detailed information on energy consumption in particular.

On the other hand we registered an increased interest compared to the previous heating period (release 1) when only one tenant was willing to use an early version of the tenant portal. This increase was due to the option of a paper version for tenants without internet access, a better communication of the service and the high energy prices at the time of the introduction.

For a further increment of the number of participants, a continuous communication with the tenants seems to be the most promising way. But there are limits defined by the socio-economic structure of the tenants. Anyway, the assumption that younger and better educated tenants would participate more - as one would suppose - cannot be proved as the two buildings are the only ones where this test is technically possible.

Usage of the service

As for the usage, there is quantitative data available only for the seven participants who chose to use the internet portal. Analysing the connection statistics we realized that only three of them really used the portal. The other four did not connect at all, despite of having received all the necessary information by letter and some reminders by email (in three of four cases).

In their usage the three participants focussed basically on the simple presentation of their consumption data (heating more than hot and cold water). The benchmarking tool, which was developed in this project to set the heating consumption data in relation with the outside temperature and prior consumption patterns, did not get quite as much attention. The third important component of the tenant portal - the self assessment tool - was mostly ignored by the tenants. Only one tenant took the questionnaire completely. The other tenants hit the page as well but stayed there so little time that it was impossible to complete could the questionnaire.

Tenant	Connection	Time (min)	Heating	Water	Benchmarking	Energy Quiz	Others
3 Tenants	118	168	19	11	6	5	12

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

Efficiency of the service

When evaluating the data we compared the consumption in the test phase with the consumption of the year before. The heating consumption data is qualified with degree days. In one case the participant is a new tenant and therefore there is no prior year's data to compare with. So we will just evaluate the results of the other twelve participants.

The services developed in this project aim at a change of the tenant's energy consumption behaviour. But there are other parameters that influence the energy consumption, too, such as the climate and the tenant's lifestyle. While the outside temperature can be measured easily we do not know if a tenant spends more time at home - i.e. because of an illness - if he goes on a long vacation of if there are visitors.

These incidents might have an even stronger effect on energy consumption than a change in behaviour. But this can be neglected when the sample is big enough so that particular incidents even out. Yet having only 12 results from our participants, this is not the case. So we have to be careful when analysing the data and apply our common sense.

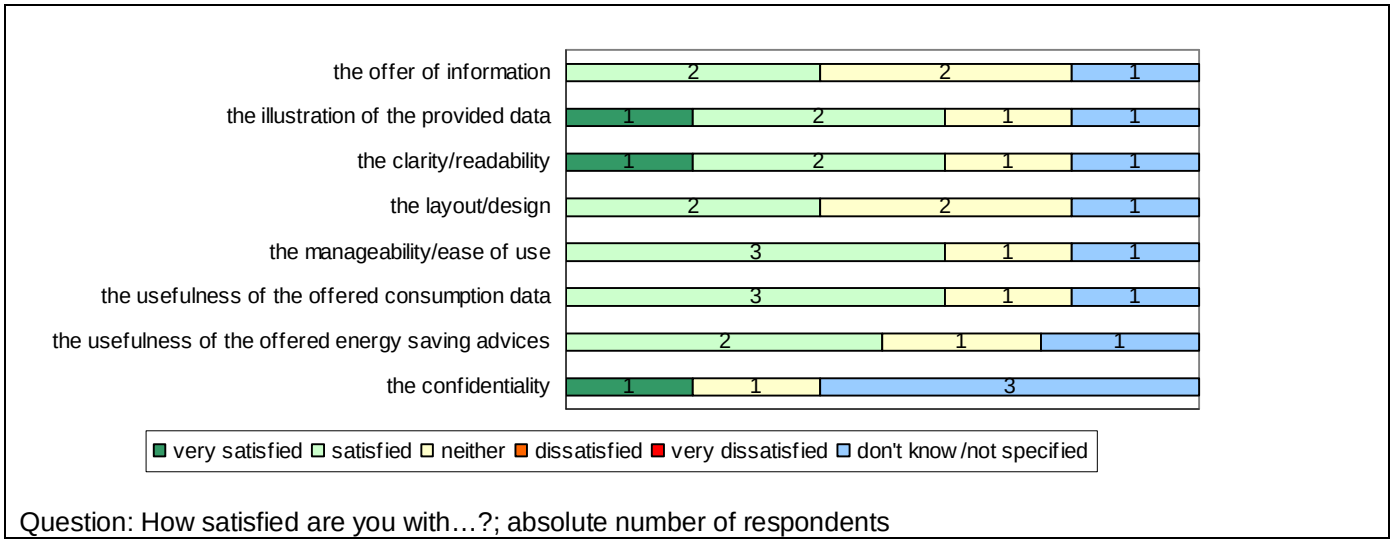
	Version	Connections	Warm Water	Cold Water	Heating
Total	Internet (7) Paper (6)	19	-4,17%	-7,85%	-9,31%
Control Group			**-4,77%**	**-0,50%**	**-8,24%**

As to be seen in the chart above, the heating consumption behaviour of the participants is slightly better than of the control group which consists of the 82 tenants of the same two buildings who did not subscribe to the service. The figures even get a little better when we take out the two highest and two lowest values in order to eliminate the extremes.

Nevertheless, due to the small number of participants and the little differences to the control group we cannot statistically prove the efficiency of our service. In case of the warm water consumption the figures of our participants are even slightly worse than the ones of the control group.

One positive result of this evaluation is the improvement of the heating consumption of our active tenant portal users. Also tenant 1 who is a new tenant and therefore has no previous history shows very low consumption figures.

Feedback on the service

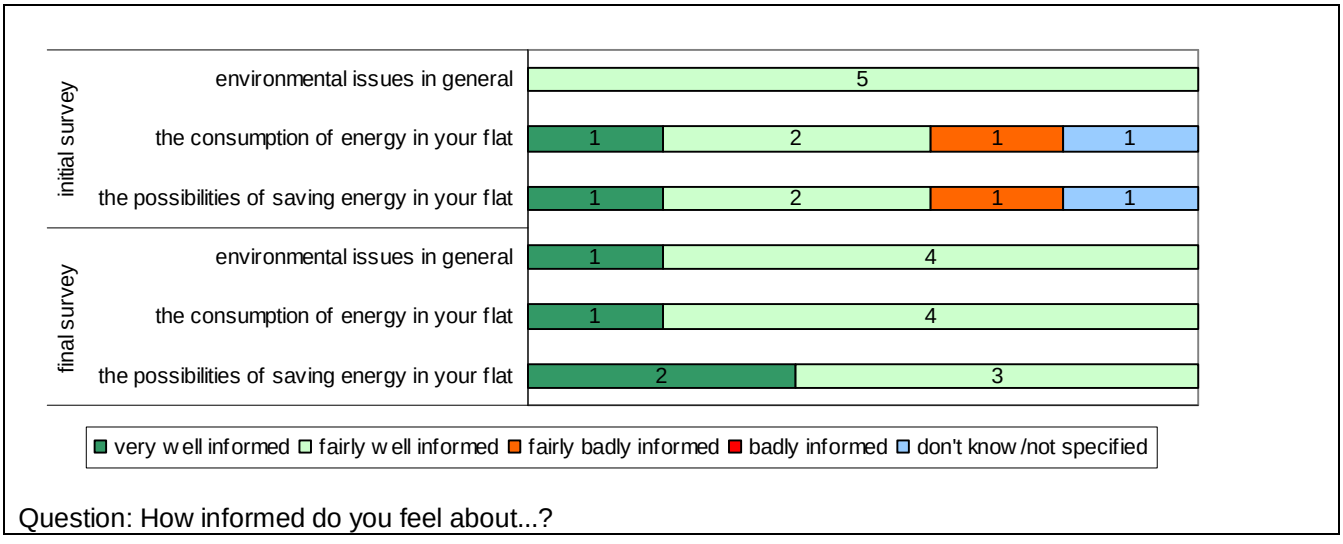


Question: How satisfied are you with…?; absolute number of respondents

Figure 27: Satisfaction with details of the Awareness Service

Based on the provided 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.

To what extent the tenants were interested in the provided data and information is presented in figure Z.3. 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 in their flats tenants were better informed after the implementation of the service.



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

Figure 28: Information about environmental issues, initial and final survey in comparison

Conclusion

Although first tendencies of an improved consumption and awareness could be shown in this field trial, it also displays the difficulties a project like this brings. To change somebody's attitude is a long-range task. Offering the possibility to control their own consumption is a first and very important step. What is required now is a constant communication with the tenant to remind him and motivate him to save energy.

6.1.3 Frankfurt case study

During the project period, data collection of monthly consumption data was made available for 284 tenants in the period from April 2007 until June 2009. For the analysis, the heating season November 2007 until April 2008 will 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 have been informed about their monthly consumption from February 2009 onwards and they did receive general information before (November 2008).

During the project period, the validation of the measured data showed in a couple of cases "no-recordings" 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.

Due to these reasons, several dwellings needed to be excluded from the analysis for technical reasons. Other dwellings had a tenant change including a period of vacancy, all these need to be excluded to get more realistic results. For the "user group" in total the consumption data of eight dwellings can be analysed and for the "control group" 188 dwellings show reasonable consumption data.

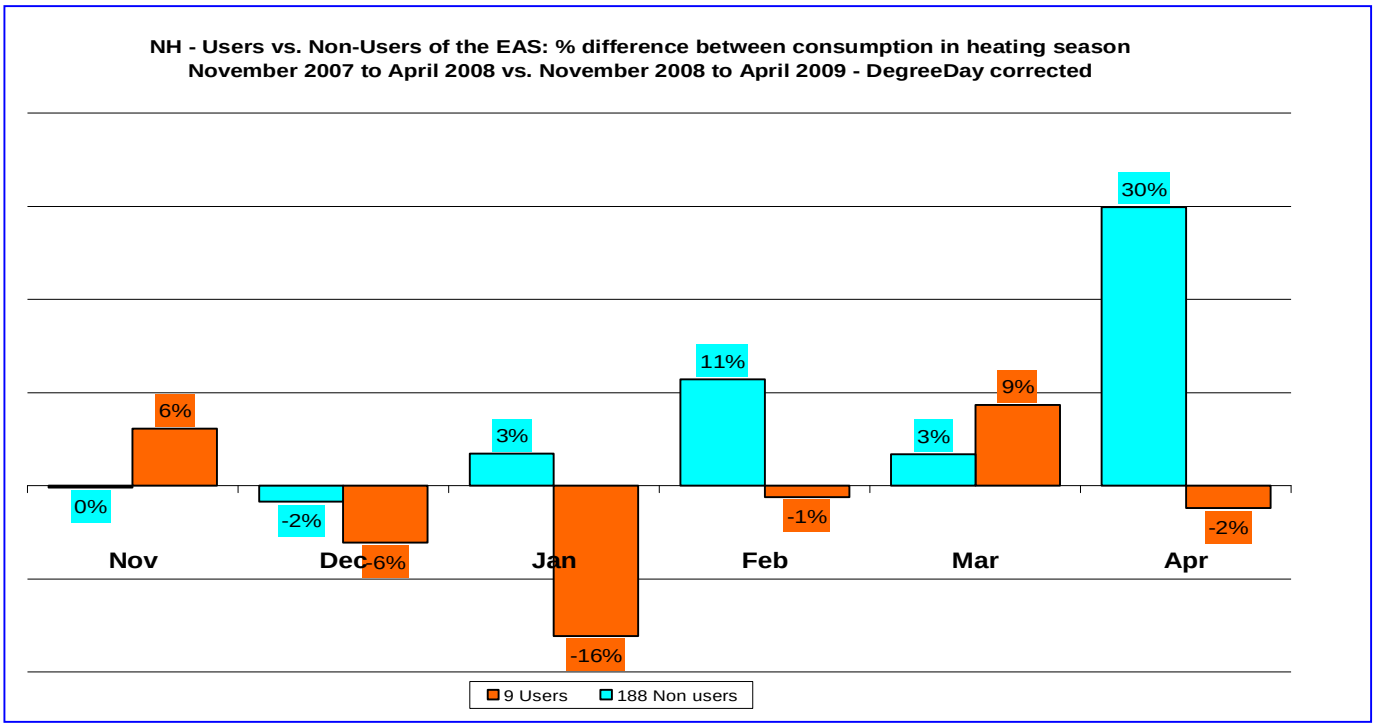


Figure 29: Differences of heating consumption evolutions (%) between previous and last heating seasons & users and non users of the Energy Awareness Services

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 above shows that the user group sees a decreasing consumption in four months whereas the control group had saved energy only in December compared to the previous year.

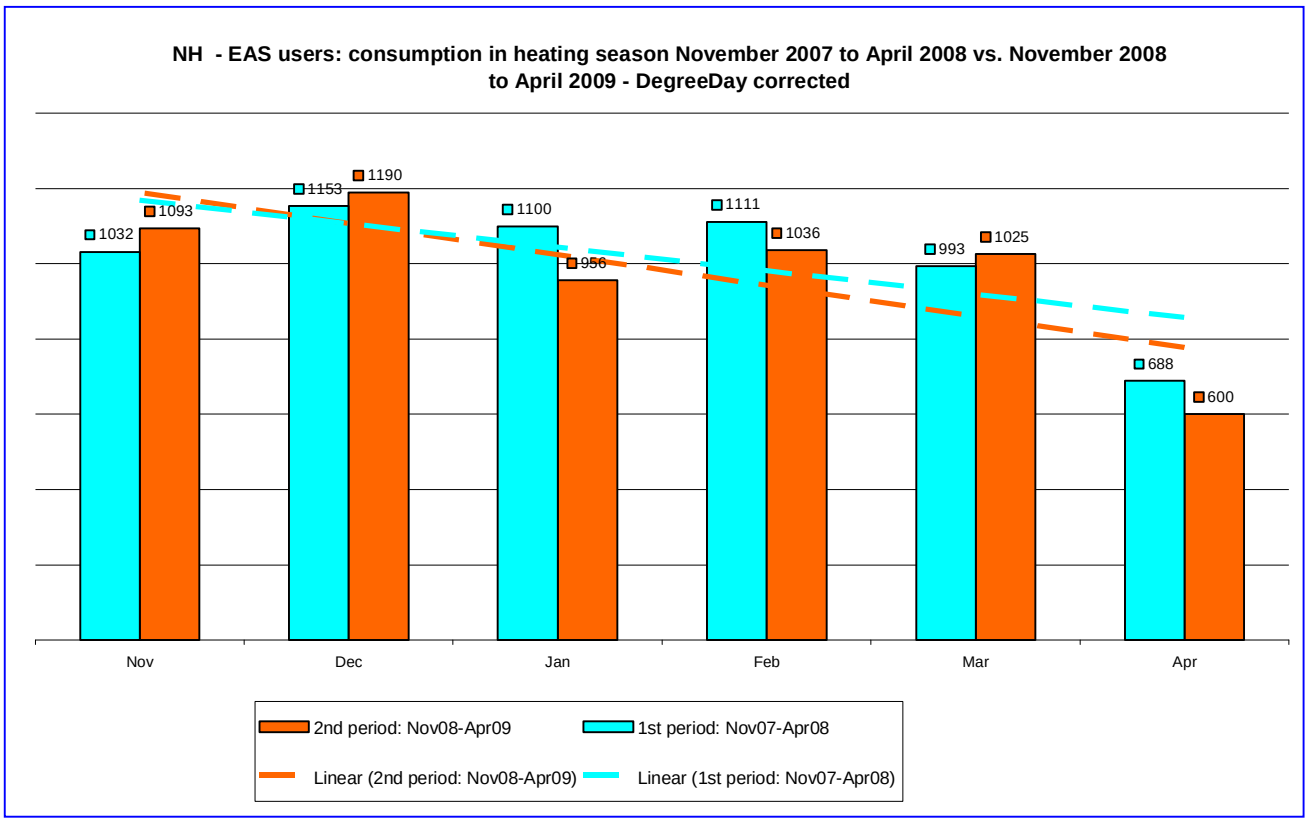


Figure 30: Comparison of heating consumptions between users and non users of the Energy Awareness Services

Nevertheless, due to the small number of tenants in the user group, it is hard to draw overall conclusions about the efficiency of the service. Half of the tenants in the user group reduced their consumption whereas the other increased their consumption.

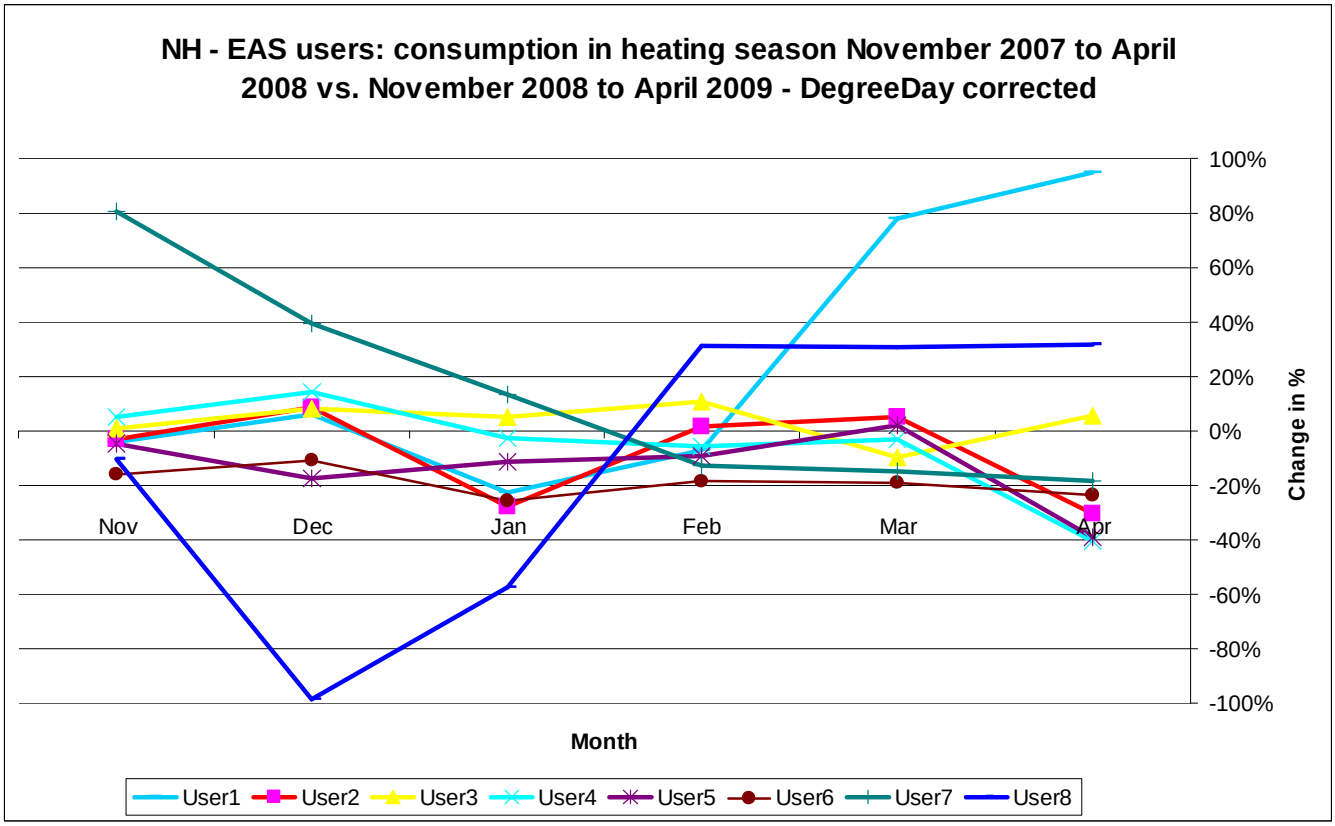


Figure 31: Heating consumptions evolutions (%) between users of the Energy Awareness Services

In the period, the users 4, 7 and 8 show high deviations up to a change of nearly 100% whereas for the other users minor changes can be seen. Analysing the data without Degree Day correction shows even higher differences up to 364% between the months of the two heating seasons. Varieties in consumption for users 3, 4 and 7 might be explained by longer holiday trips, a baby is born or other changes in life and not by a behaviour change.

6.1.4 Karlsruhe case study

The measurement and data logging system which was employed in the pilot test buildings is described in more detail in D6.3. Also, measurement details are discussed there. In this section, the main experiences made during the pilot phase are presented and conclusions are drawn.

In this pilot phase of the tenants portal, running 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) have only been informed about the availability of the new portal and the access procedure. For the tenants in Kranichweg 4 (28 flats), more information had been 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. But in these 2 additional buildings, no portal was offered. The consumption of heating energy and domestic hot water was measured here in the same way than in the other 2 buildings.

The 4 buildings, construction year 1967, provide 136 flats altogether, and have been retrofitted recently to achieve a very good insulation standard, with an investment of about 4 mill. €. 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 kWh/m2 before retrofit to about 80 kWh/m2.

As the measurements over 2 periods have shown, the flats display a big 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 (kWh/m2.a) in 2007 and 2008 for the 4 buildings (and taking the average of the 2 buildings without tenants portal), the development between 2007 and 2008 is illustrated in the chart below:

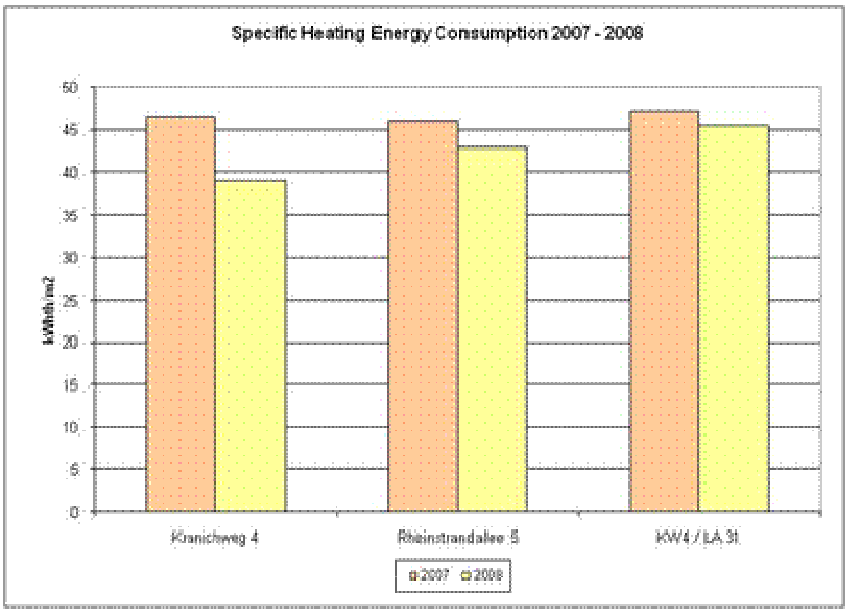


Figure 32: Specific heating energy consumption (kWh/m2) of the two “portal buildings” and the average of the two other buildings in 2007 and 2008 (data adjusted for changes in degree-days).

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 prove the effect of 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 has given the following result:

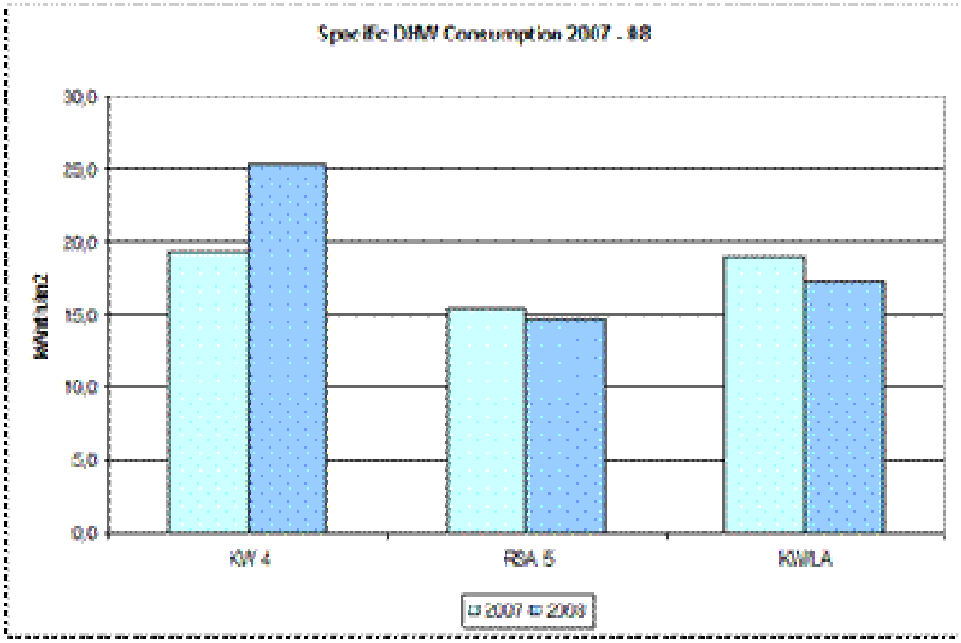


Figure 33: Specific domestic hot water consumption (kWh/m2) of the two “portal buildings” and the two other buildings (average) in 2007 and 2008

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 (see D6.3 for more details) has shown, 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 these tenants replacements had happened, and leaving the data of all other tenants resp. buildings un-changed, results into a quite different pattern:

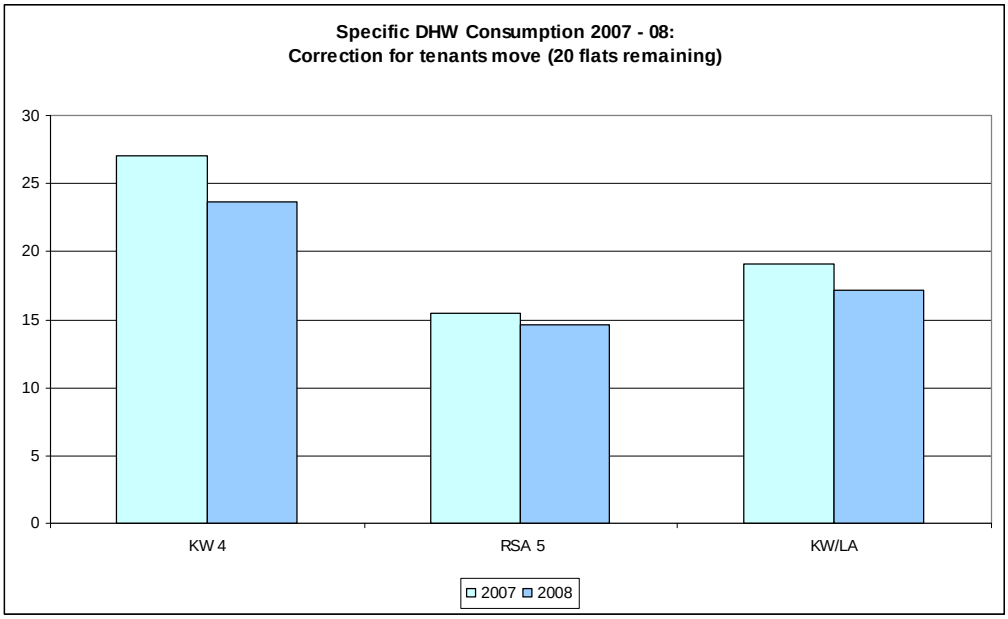


Figure 34: Specific DHW consumption

Specific domestic hot water consumption (kWh/m2) 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 “wishful” result. Again, as said above, statistics are too poor to be able to draw exact conclusions on user behaviour and influence exerted by the availability or non-availability of the portal. For instance, the influence of energy price increase, which has happened in 2007, should be examined, further, the big difference of the domestic hot water consumption in the 4 buildings would have to be explained (perhaps also a statistical effect).

Concluding, 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.

6.1.5 Moulins case study

For the record, the project of Moulins Habitat aimed at offering tenants a tool for the follow-up of their water and energy consumptions. With the calendar of the project Save@Work4homes and on the basis of the answers obtained during the first survey, it was decided to limit the experiment to 80 flats distributed on Moulins-South and the down-town of Moulins.

Although the Internet portal and that the follow-up of water consumptions are operational, it is today impossible to estimate the results obtained thanks to the implementation and to the deployment of this service. Indeed, Moulins Habitat met numerous difficulties throughout the progress of the project, the difficulties having caused such a delay that any relevant evaluation is today impossible.

- First of all, as regards the follow-up of the consumptions of electricity, it is important to note that in spite of a blanket agreement between EDF and Moulins Habitat within the framework of the rehabilitation of about 2 000 dwellings, we lost one year in the negotiation engaged with the aim of the replacement of all the meters of 80 tested flats. Indeed, due to technical specifics of the tool set up with VIZELIA, it was necessary to replace all these meters dating the 70’s by electronic meters to ensure the compatibility with the sensors. Because of this delay the data collection relative to the consumption of electricity will be operational only during summer 2009. Added to the technical difficulties were difficult negotiations with the aim of the replacement of the existing meters by electronic meters.
- Furthermore, the other difficulties met with GDF and GRDF came to be added to those met with EDF and ERDF. Indeed, the negotiations aimed at the replacement of meters and to press the VIZELIA technology on that of their provider of telemetering failed. So no measure was able to be realized on consumption of gas of housing equipped with an individual heating system. Moulins Habitat has to intend thus today to place the second independent meter downstream to those of GDF and GRDF. As a consequence, the collection of these data can be operational only at the end of the year on 2009.
- All the met difficulties does not thus allow Moulins Habitat to make a relevant evaluation of its project due to the delay taken in the deployment of the system, bound mainly to the difficulties met with the institutional energy providers.

Maybe these difficulties are a result of the call for tender at the beginning of the project. Indeed, following this call for tender, VIZELIA was chosen by Moulins Habitat to accompany them throughout the project. Except VIZELIA not being historically bound to the institutional actors, we can suppose that it did not contribute to the success of the project and to the deployment of the system of data collection of consumptions, for the benefit of the tenants, in the time granted.

However, it is important to note the positive return of the tenants on the ergonomics of the internet portal by which they reach their data of water and energy consumptions.

6.1.6 Berlin case study Self assessment Tool

STADT UND LAND has tested the efficiency of the self assessment tool first of all on the employees. The test has been proposed on the internal portal of STADT UND LAND and 20 percent of the employees have answered and commented on the assessment tool.

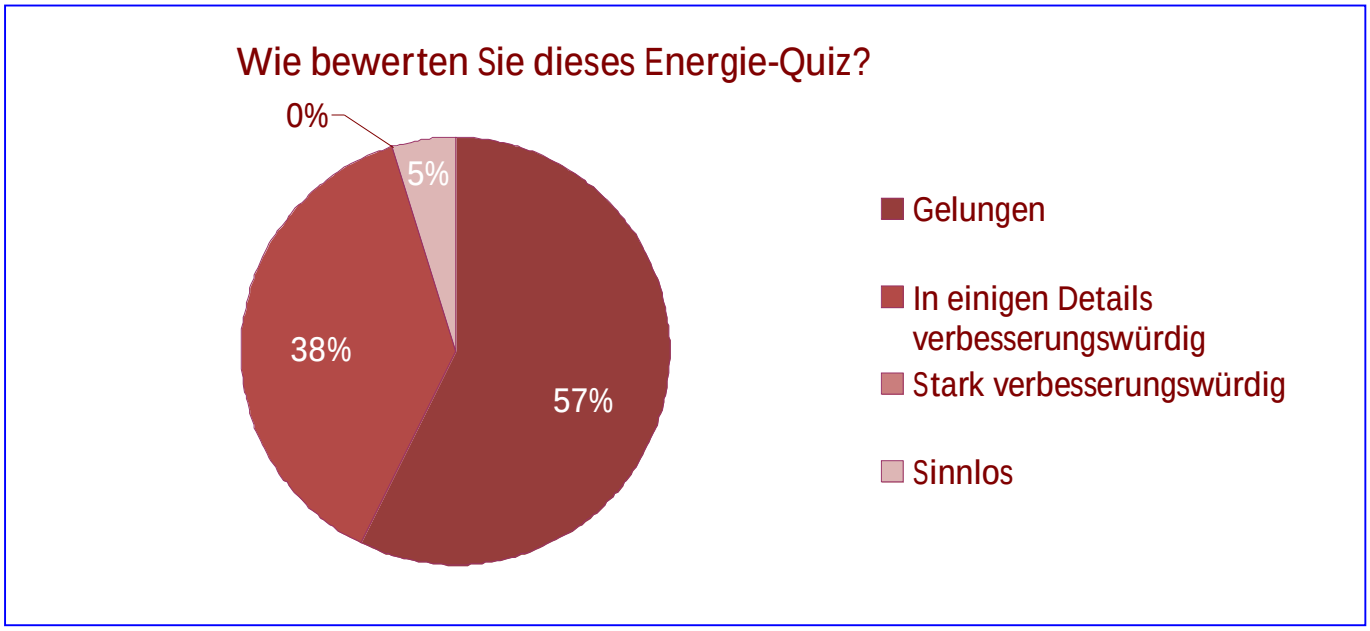


Figure 35: How do you like the Assessment tool?

57 % of the employees found the survey positive and 38 % had a few changes to propose. The vocabulary used by the tool should be easier and some questions must be better explained. The employees of STADT UND LAND are aware of environment issues and could answer and correct the self assessment tool also because of the fact that STADT UND LAND has an EMAS certification. These results have been used for the final version of the internet portal for the tenant.

6.2 Efficiency of the services not connected to Internet

Belfast case study [Self assessment tool PDA-based]

Around 160 tenants completed the Self Assessment Tool via the PDA service. However, NIHE doesn't have the capacity to measure the consumption data from these tenants, because of the personal data protection which does not allow the energy providers to communicate the gas consumptions to the housing company.

Berlin case study [Paper-based users]

For the evaluation of the consumption of the tenants who received their information by letter please see 6.1.2.

Belfast Case Study [Use by the tenants of heating controls]

In Belfast, an initial survey of 100 mainly elderly tenants found that 38 stated that they were not quite sure how to use their heating controls effectively. As part of this project they were offered more in-depth advice by trained energy advisers. Of the 38 tenants contacted, 33 were still resident at that address and were given more detailed advice and training in the use of controls at the end of 2007. NIHE contacted Phoenix Gas at the end of 2008 to get gas consumption data for 2007 and 2008 for the 25 tenants who used this fuel (the other 8 used oil). Due to Data Protection issues, Phoenix could only supply 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. However, the records for 9 out of these 12 tenants showed they used less gas in 2008 after reciving more in-depth advice compared to 2007.