Saving Energy in (Social) Housing with ICT

Guide for Replication of the Introduction of ICT-based Services for Energy Efficiency

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ICT services for resource saving in social housing

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Statement of originality

This deliverable contains original unpublished work except where clearly indicated otherwise.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

Executive Summary

The 'Guide for Replication' has three parts. First, smart-metering and ICT-enabled energy saving services are introduced so stakeholders with no experience and how these can be approached. Second, the Guide provides stakeholders with steps to be taken at various stages of project deployment. For each step, relevance for stakeholders is pointed out and lessons learnt provided for individual stakeholders. Finally, key information for project set-up and checklists introduced earlier are collected in the Annex.

***Innovation triggered**: The integration of lessons learnt from several CIP-projects ensures lessons learnt, their impact and the recommendations cover a wider range of implementation, deliverables and individual experiences which at present are based on these from 17 social housing pilot sites (including the 7 BECA pilot sites). This document is a Guideline for any Social Housing company, IT or Measurement provider trying to start ICT-enabled energy efficiency services and / or how to best approach companies with no service yet in place..*

'Part A: Setting the Scene' introduces the potentials of ICT-based energy saving services. A key requirement is data enabling automatisation and information of tenants. This is often achieved by means of installing smart-metering. Energy Awareness Services (EAS) and Energy Management Services (EMS) are in the focus of the introduction. The Guide and the 'Five-Step' underpinnings are being introduced. The key steps are: Set Goals, Corporate, Plan, Implement, Monitor & Evaluate.

Various scenarios how EAS and EMS can save energy are being described: The role of consumption aware tenants is explained as much as their options to manage own consumption. Energy management extends to control of heating systems and renewables. Energy managers and Social Housing Providers can be empowered to manage energy consumption in buildings and neighbourhoods. The section is enriched with details about implementations in the EU-funded ICT-PSP projects BECA project (Balanced European Conservation Approach) and eSESH (Saving Energy in Social Housing with ICT).

'Part B: Guide for Replication' explains necessary steps to be taken by stakeholders in order to successfully Set Goals, Corporate, Plan, Implement, Monitor & Evaluate and ICT-enabled energy saving services. The relevance of individual steps for individual stakeholders is being highlighted at the beginning of the given section. Key stakeholders are Social Housing Providers, Local and City Councils, IT-Service and Measurement Providers, Energy Provider, Social Services, Tenants and Policy Makers.

Lessons learnt in ICT-projects BECA and eSESH are provided for each stakeholder at the end of the relevant chapter. Checklists are provided for individual steps.

Goals require thorough review of potential benefits risks of service implementation including the regulatory environment and national and European level. Identification of existing hardware and access to it is needed to define realistic goals.

Cooperation with numerous stakeholders is required to ensure operation of the service and to reduce costs. For instance, measuring cabinets might belong to Third-Parties and depending on the local structure various stakeholders need to be informed of measures to be taken. Since awareness services require tenants to become active communication is key and successful means include the identification of 'champions capable of informing and recruiting actors to use the service.

Planning should begin with defining the scope and focus to ensure communication is transparent. Requirement capture includes functional as much as non-functional items which can be collected, for instance, by the use of focus groups. An important aspect is ensuring data protection. Selection of Use Cases and Process models (provided in the Annex) as well

as identifying the best specifications and architecture best suited for the current environment allows for review of individual systems.

Implementation requires clear definition of roles and response plans. While testing the system as such is essential, promotional activities have to start early in order to recruit and train the professionals and tenants operating the systems.

Monitoring and evaluation of the service ensures that the full potential of the system implemented is achieved. This includes analysis of recorded consumption data as well as interviews of users. Standardised methods can be used (e.g. IPMVP). To optimise future exploitation and replication, the business model can be revised.

'Part C: Annex' collects technical details, regulatory and legal developments and all checklists introduced in 'Part B: Guider for Replication'.

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PART A:
SETTING THE SCENE

‘Part A: Setting the Scene’ introduces the potentials of ICT-based energy saving services. A key requirement is data enabling automatisation and information of tenants. This is often achieved by means of installing smart-metering. Energy Awareness Services (EAS) and Energy Management Services (EMS) are in the focus of the introduction. The Guide and the ‘Five-Step’ underpinnings are being introduced. The key steps are: Set Goals, Corporate, Plan, Implement, Monitor & Evaluate.

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1 The case for implementation of BECA services

Since the 'Guide for Replication' is written to integrate input and experience from various projects, Energy Awareness Services are referred to as EAS (RUAS in BECA) and Energy Management Services as EMS (RMS in BECA).

As car drivers, we are very sensitive to costs; we react to the smallest of changes in prices at the pump and try to avoid unnecessary journeys. Likewise, we make much fuss about changes to public transport ticket prices and respond by switching between modes of transport if one of them becomes more cost competitive.

But once at home, we seem to take little if any notice of the cost of energy: Hardly anybody knows how much they are paying for heating their homes and how large their electricity bill is. What is more, there is very little awareness about how changes in day-to-day behaviour affect actual costs. It seems that most residential users consider the size of their monthly (or even annual) bill for electricity and heating as being outside of their own control.

A major reason for this is that use of energy tends to be physically invisible to consumers. Only the status and comfort of using energy will be visible to the residents themselves and to others. Some might consider a reduction of energy consumption and increase in efficiency as a threat to comfort or status. But even for energy users who are behaving "rationally", ineffective energy use does often not influence their lives substantially since energy costs are typically only a small part of the overall budget, and/or are not borne *directly* by themselves.

The logical result is that people have so far shown little enthusiasm for adapting patterns of energy consumption to save costs. Tenants in social housing – and people everywhere – today often use energy for heating, cooling and appliances in their dwellings in wasteful ways without realising the impact not only on the environment but also on their wallet.

This situation will need to change markedly if Europe is to succeed in achieving energy savings large enough to prevent a global climate crisis – without endangering affordability of heating and electricity for all citizens in Europe. For example, the World Business Council for Sustainable Development[1] has estimated that to reach well-established greenhouse gas (GHG) reduction targets (limiting global temperature increase to 2 degrees by 2050) the world's six biggest regions (including the EU) will need to cut energy use in the building sector by about 60% as compared to the "business as usual" projection. In other words, huge efforts will be needed to lower energy consumption in the residential building sector across the EU.

One of the main ways through which sustainable change can be achieved is by making best use of smart technologies. Smart meter enabled energy efficiency and demand response services enable us to support tenants to realise the impact of their energy behaviour in a timely fashion, thereby allowing them to adjust and correct how they use energy in line with the real "underlying demand" they have – not to consume energy, but for warmth, coolness, a hot bath, dry washing etc. A wide range of feedback tools has become available to energy utilities and tenants in the form of displays, websites, information on mobile devices and TV, informative bills etc., see box below.

What is Smart Metering?[2]

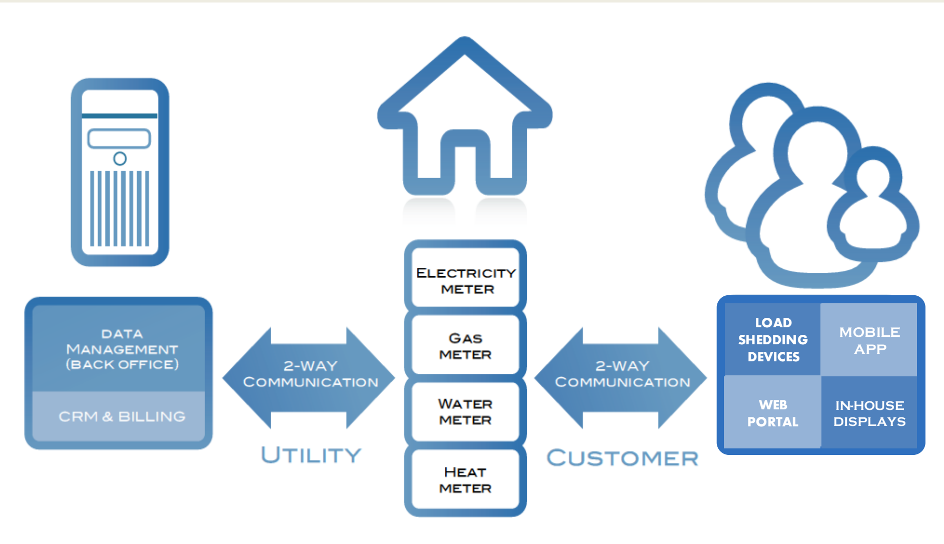
Like conventional meters, Smart Meters measure amounts of energy or water flowing through them. But whereas conventional meters must be read manually, and the consumption calculated since the last reading, Smart Meters provide specific information on how much energy or water was consumed, when it was consumed and at what tariff – a continuous calculation that conventional meters are incapable of. Provided with detailed operational data the network operator is also able to decrease the cost to serve, by targeting investment in the network more accurately and thus maximising the benefits of system reinforcement. But Smart Metering offers more:

Digital technology: Smart Metering takes advantage of all the advances in modern digital technology; it enables data communication and can measure and deliver more information. More quantities and larger amounts of data can be stored until collected and meters can also be re-programmed or re-configured remotely.

Communications: Smart Metering enables long range communication with the energy company and short range links into the home. Consumption data can be read remotely and tariffs can be updated remotely. Smart Metering provides a communication gateway that functions as an interface between devices in the home and provides customers with real time data.

Control: Smart Metering allows for remote configuration and adjustment. This can be used in a number of ways, for instance, for supplier switching, remote reconfiguration of the meter as a credit or pay as you go meter, as the customer chooses to switch their supply contract. Finally, the meter can be used as the interface of a home automation network.

Better operation of networks: Smart Metering can greatly assist the network operator by providing detailed operating data from the ends of the network. Power quality can be measured by the meters and the network adjusted to improve its overall operation. Outages or leakages can be detected faster and system recovery monitored, minimising inconvenience to customers.



Using these functionalities Smart Metering can support a whole range of new services. Many of these features are already available and in use for large commercial or industrial consumers. The revolution in Smart Metering is seeing these features transferred to the residential and small commercial sectors with significant benefits to consumers, utilities, environment and society.

Development and widespread implementation of smart services offered to consumers (tenants) as well as providers (housing companies, utilities, etc.) are essential for achieving actual efficiency improvements from behavioural changes which effectively exploit saving potentials.

It has been reported that implementation of smart metering based feedback services does not always lead to energy savings. We need to be fully aware of the fact that *technology alone is not sufficient*, but it is at the same time clear that without these feedback tools and additional metering services customers simply lack the information for taking effective action towards greater energy efficiency. Other preconditions need to be in place as well. For example, consumers need clear incentives to take the extra effort for saving energy – a point which is particularly important as the advantages of smart metering are to be compared with the related costs to be borne by customers – not necessarily in monetary terms, but in terms of privacy intervention and other non-monetary issues, e.g. effort for leaving fixed habits and adopting new energy-saving behaviours.

Another objective for implementing new metering technology is related to improving operational efficiency on the part of utilities and housing providers, e.g. to increase performance at system level, manage use of renewables, reduce non-technical losses, and for remote reading and switching. Utilities can today operate demand response and direct load control programmes in order to limit the peak load that has to be provided to the market.

The **BECA project** shows how both tenant-oriented and utility/provider-oriented technologies can be used for sustainable change. BECA's focus is on residents in social housing, i.e. those citizens who are in most need of reducing their energy bill as they are faced with rising prices and an increased risk of what is now being called "fuel poverty". Even in those instances where tenants are not billed directly because renting expenses are born by the municipality – this is the case for most welfare recipients in Germany – energy savings in this segment of the market are of high importance because of European municipalities' dire need to reduce their spending.

Saving Energy in Social Housing with ICT: The BECA project

Supported financially by the European Commission under the ICT Policy Support Programme, 19 organisations were cooperating in the BECA project to provide ICT-based energy management and energy awareness services directly to social housing tenants.

The project designed, developed and piloted new solutions to enable sustained reductions in energy consumption across European social housing. This was accomplished by providing usable ICT-based services for Energy Management (EMS) and Energy Awareness (EAS) directly to tenants as well as to social housing staff.

The project contributed to meeting Europe's emission targets by initiating significant reductions of energy consumption in the European social housing sector. This was achieved by providing effective ICT monitoring and control of local generation of power and heat as well as by offering social housing providers, regional and national government the data they need to optimise their energy-related policy for investment decisions at national, regional and organisational levels.

BECA services for social housing tenants were evaluated through ten pilots in seven countries across Europe, Eastern Europe in particular. More than 5,000 social housing tenants were given access to BECA Energy Awareness and/or Energy Management Services in the pilots.

BECA was led by the relevant government authorities and social housing providers, and coordinated by empirica, an internationally active research and consulting firm from Bonn, Germany. Contributors included global players in electricity supply, smart metering and home / building automation and international players in building networks and tenant portals as well as local specialists, ensuring a high standard of technical work and the achievement of key project objectives at each pilot site.

BECA has two main components: Energy Awareness Services (EAS) and Energy Management Services (EMS).

Energy Awareness Services (EAS) work by delivering to residents data on their current energy consumption at home so that they can make savings day by day. In order to bring about the hoped-for changes in behaviour, hints and guidelines for effectively saving energy are sent to residents' PC, TV or smart phone; alternatively and where preferred, a set of personalised recommendations is presented by letter or in a personal conversation with an energy coach.

Energy Management Services (EMS) exploit the capabilities of smart metering technologies for greatly improved monitoring and targeting processes, both of which are an essential part of energy management for residential buildings. More effective metering and benchmarking of end-uses helps operators to understand and manage their buildings better, enabling more efficient energy management (including combination of renewables with local power), fairer billing for energy use and introduction of more powerful incentives for saving, and dynamic, intelligent peak shaving (also called peak clipping), i.e. reduction of peak demand levels.

BECA Services have been made available to more than 2,500 dwellings in six countries, 16 cities and 28 neighbourhoods across Europe. Altogether, almost 5,500 people have access to BECA services – 24 hours a day and seven days a week. In addition housing operators are being provided with services that make energy system management more efficient and/or to prepare energy saving investment decisions in ways which ensure best value for money. Twelve organisations responsible for providing housing for more than 100,000 households are now using BECA services.

1.1 From potential to successful practice

Smart metering has been around for some time already, but take-up of applications which effectively enable consumers to take charge of energy efficiency has so far remained below expectations across Europe. It is for this reason that the European Commission has stated that "we are now at the point where we need to pass from traditional consumer information to their empowerment"[3]. What does it take to move from potential to successful practice?

Available evidence from established practice clearly shows that implementation of smart metering based services needs to be well planned and prepared, and must take full account of the local implementation environment. Most importantly, all main stakeholders need to be made aware that they can expect concrete benefits from introduction of smart metering. Under given circumstances in a city of region, particular types of services are to be given priority over others, depending on the incentive structures and stakeholder preferences in place.

The BECA experience shows that a unified approach can be used for all types of implementations, but it then needs to be translated it into practice using a whole range of adapted strategies depending on local requirements and implementation contexts.

For example, there is large variety regarding the utilities used for supplying (social) housing with energy. In most cases electricity is used to supply appliances in dwellings; in some cases electricity is also used for heating water and, especially in France, for room heating. It is more widespread in Europe, however, to use gas for heating, with some recent developments towards replacing it by renewable energy sources (RES) such as is the case at the Solingen BECA pilot site, where wood pellets are used. RES are also used to heat water at the BECA sites in Catalonia and North Italy and their management is also target in several pilot sites.

Heating is also sometimes made with local heating grids which can be optimised to reduce heat losses and save energy and costs as well as for the grid operator (in most cases housing organisation) and for those who are paying the bills (either tenants, the municipality, or both).

Different energy types ask for different service architectures: the normal user without technical background needs easy tools to operate the service whereas those people involved from the housing companies are most often technical experts, which means a more technical approach is needed.

For gas heating minute data might not be the right frequency for the tenant to understand his energy pattern and to provide him with hints to save energy – however minute (or even higher frequent) data is interesting for the professional user of the housing company in order to improve the operation of the heating grid.

What is more, energy types are used differently: for electricity higher frequencies might be more interesting as some appliances are used the whole day long (fridge, freezer, water heater, heating) whereas other appliances (light, washing machine, TV, hairdryer, PC) are used only some minutes/hours.

In many cases it is preferable to include sub-metering to identify appliances which are high consumers, also for peak shaving services to cut-off high consumers (heating, water heater) for a couple of seconds/minutes.

Users are not homogenous and apart from easy usage of service tenants also need to have the opportunity to adapt the service to their personal needs (frequency, target setting and automatic alarm messages, e-mails/text messages/letter, web/Smartphone, book energy coach for further help).

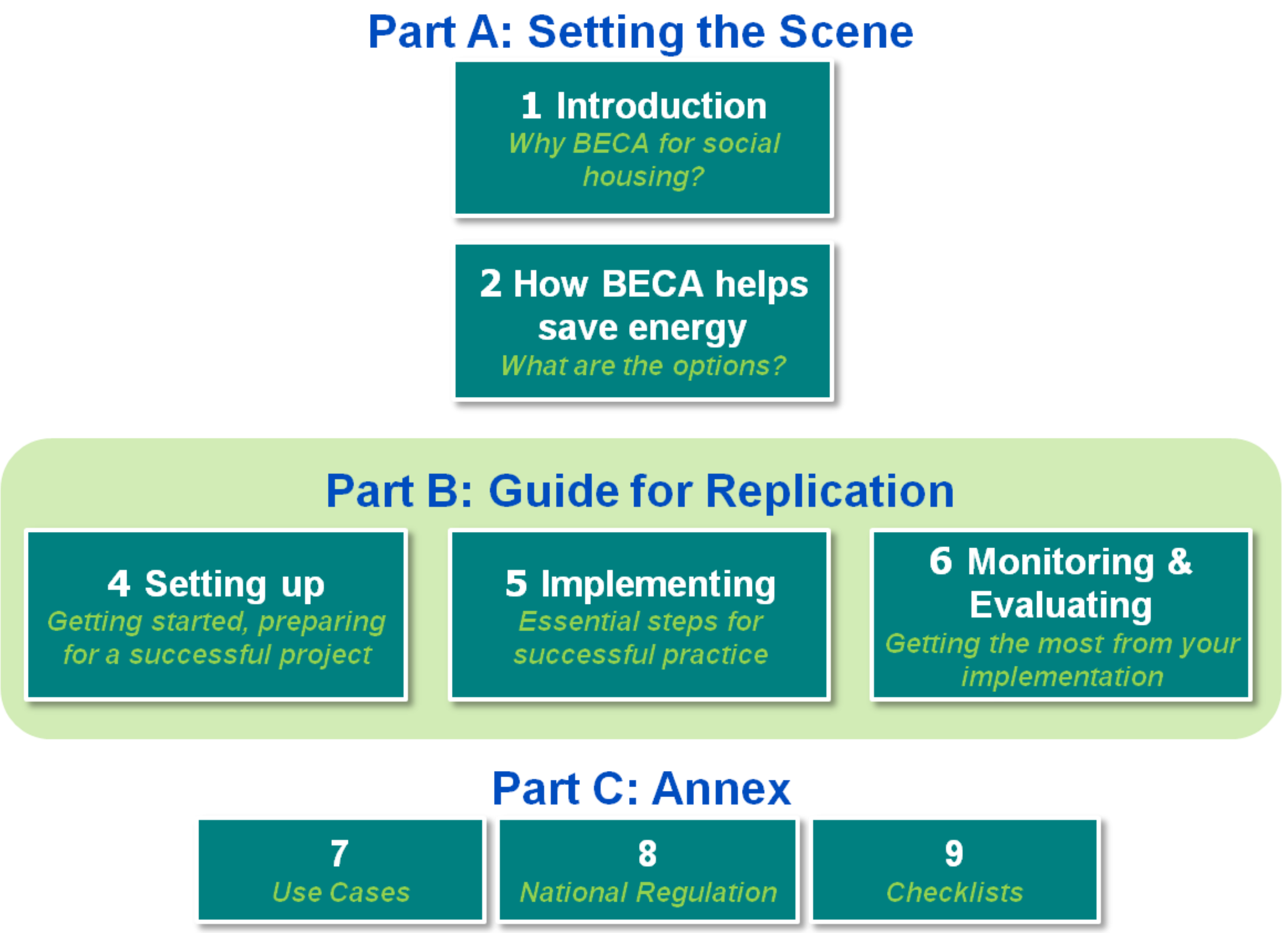
For an easy understanding it is necessary to help to translate energy use (most often in kWh) to a unit which users understand, preferably the national currency (€ at BECA pilot sites).

Different means of ICT are necessary and there are several successful examples available in this guide.

1.2 About the BECA Guide

The present guide has the goal to support and enable housing organisations, utilities, IT-service providers and other key stakeholders to easily replicate and implement BECA services, tailored to their own needs and local conditions.

Exhibit 1: Structure of the BECA Guide



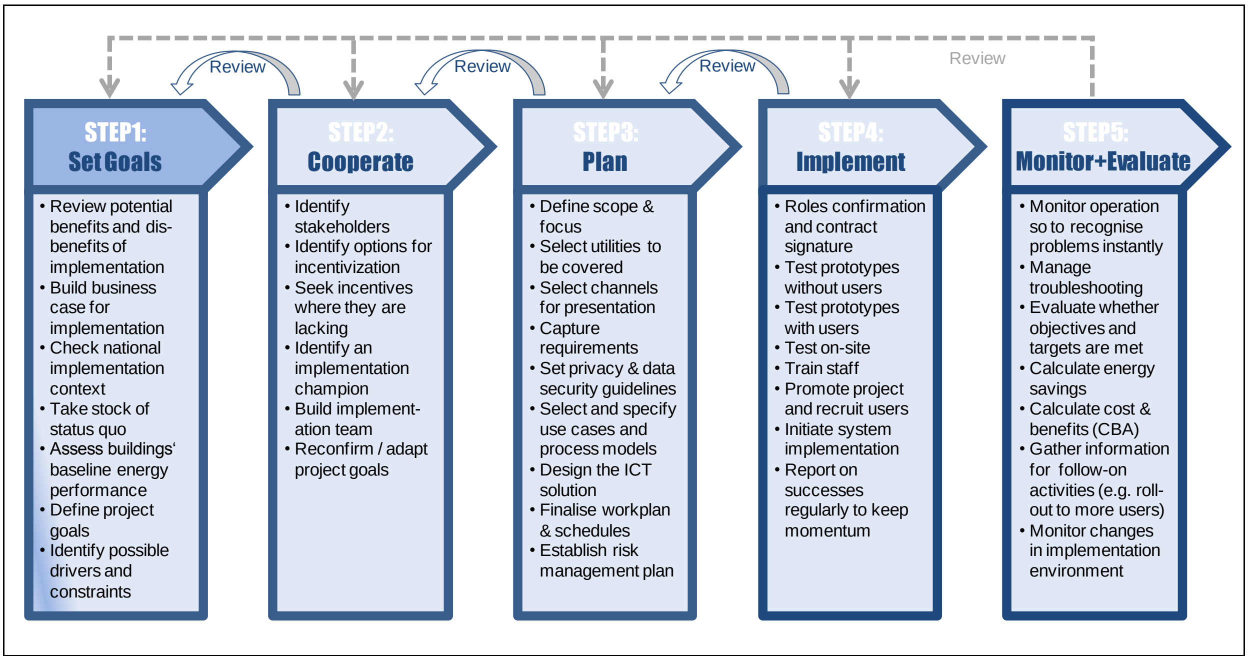
1.3 How the Guide is structured

The first three chapters of the report attempt to set the scene for implementation of BECA at other sites than those in which the services have been piloted. These chapters provide readers with a general understanding of BECA services and how they help achieve improvements in energy efficiency. Following the introduction in the present section, **Chapter 2** presents a short summary of **service types** according to their main focus:

- Increase energy awareness of tenants (section 2.1);
- Enable tenants to manage energy consumption more smartly and effectively (section 2.2);
- Manage the use of renewables within a mix of energy sources (section 2.3);
- Enable providers to manage tenants' energy consumption (section 2.4) and
- Provide building managers with full transparency of energy consumption patterns in order to enable them to focus investments on where they will be most effective (section 2.5).
- Referencing examples from BECA and eSESH to different approaches for implementation are given as examples (section 2.6)

The main part of the present document is made up by the **BECA Guide to Replication**. It leads readers through the major phases of an implementation project (see figure below). The aim here is to describe the full process of service introduction, including when to involve what kind of stakeholders for what purposes.

Exhibit 2: Guide for Replication: 5-Step Implementation Process4



Chapter 3 covers the **project set-up** phase. The implementation plan has to be based on a careful assessment of the requirements and the local implementation context. In particular, the national regulatory environment needs to be understood. For this reason, **Chapter 4.1** is concerned with setting the goals of your project: What do you want to achieve? Once goals are set, the best possible approach to meeting them can be defined and checked against the implementation context including drivers and barriers. For the latter it is necessary to take a look at the national implementation context; Chapter 4.1.2 gives a brief overview of the smart metering landscape across Europe and discusses implications for implementation projects.

Chapter 4.2 deals with the need for cooperation. It discusses the **main stakeholder groups** in the market for energy efficiency. Experience so far clearly indicates that involvement of as many of the main stakeholders as possible from an early stage of the implementation process is of vital importance for its success. **Chapter 4.3** is about **planning implementation**, comprising issues such as defining scope and focus (utilities to be covered, presentation formats etc.); requirements capture; how to take care of data security and privacy protection; designing use cases and process models; and specification of the ICT solution.

Chapter 6 guides readers to the main steps in implementing the service. While it may be possible to roll out services to all users at the same time, in practice a step-wise approach is more likely to be feasible. In the latter case, getting the first roll-out phase right is essential for the overall success of the endeavour. **Chapters 5.2** and **5.3** discuss **system testing** and **staff training**, respectively. Experience from best practice indicates that both of these steps need to be managed diligently to prevent bottlenecks of either technical or human capital nature from jeopardising the success of the whole implementation. Other vital steps include **user recruitment** and **promotional activities** (**Chapter 5.4**), i.e. identifying the buildings in which to introduce the services first and selecting and winning those users (residents) which are deemed most suitable for the purpose.

The third part of the Guide for Revision (**Chapter 5**) deals with **monitoring and evaluation** of the implementation's success. This comprises trouble shooting (**Chapter 6.1**) as well as evaluation (**Chapter 6.2**) and cost-benefit analysis (**Chapter 6.3**), i.e. careful assessment of costs and monetary benefits. Results of the evaluation and the cost-benefit-analysis need to be fed back to managers so that interventions can be taken whenever needed, and as input for planning future steps in advancing energy efficiency. **Chapter 6.4** concludes the document with an **outlook** to emerging trends which are expected to play a major role in strengthening the business case for roll-out of smart meter enabled energy efficiency and demand response services in the near future.

The **Annex** contains three parts. The first part (chapter 7) describes the 13 BECA use cases and process models. The second part (chapter 8) presents an overview of the current state of policy-making on smart metering in each of the EU's member states in tabular format. The last part (chapter 9) is a set of checklists for successfully planning the implementation of BECA services.

Depending on the background for your project, the reader's, interest in the topic of this Guide, you may want be interested mainly in specific parts of the report:

- **Managerial staff of housing companies** are recommended to study, in particular, section 4.2 as well as the other parts of the Guide for Replication;
- **Technical staff of housing companies and other providers** will be most interested in section 4.3 (Designing the BECA implementation) as well as the documentation of practice in BECA pilot sites to be found in the Annex;
- **Local policy-makers** and anybody with responsibility for obtaining the public's support for an BECA implementation are recommended to focus their attention to sections 1-3 plus chapters 4.1 and 6.4;
- **Representatives from utilities** may want to start with chapters 2 and 4.2, which will give a good understanding of the main strategic decisions to be taken to successfully participate in projects for implementation of smart meter based energy efficiency and demand response services in the social housing sector.

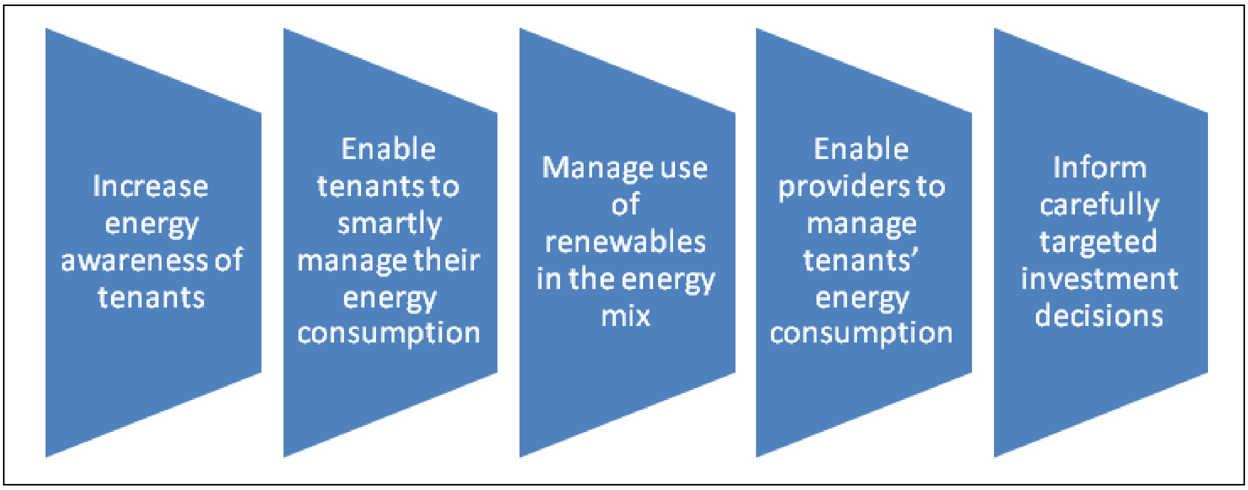
2 How BECA helps achieve energy savings

There are several ways to use smart technologies for achieving energy savings in the residential sector. Not one fits all but services need to be designed according to all main stakeholders involved and their specific requirements, preferences and objectives. Within the BECA project services addressing the following objectives have been piloted:

- Increase energy awareness of tenants in order to prepare the ground for changes in behaviour towards improved energy efficiency;
- Manage use of renewables in the energy mix, e.g. by automatic evaluation and information feed-back to operators for continuous system optimisation;
- Enable tenants to manage their energy consumption in smart and efficient ways, e.g. by cutting off devices and adapting heating schedules according to saving potentials and variations in energy scarcity (e.g. for electricity: peak shaving);
- Enable providers to manage tenants' energy consumption for greater efficiency, e.g. by monitoring the district heating grid and inform about malfunctions, or by centrally managing appliances to avoid peak time consumption;
- Increase knowledge about energy consumption of the building stock to more precisely target investments to stock which is wasting energy.

In the following these five application areas will be described in more detail.

Exhibit 3: Application areas for energy savings through BECA



These five application areas will be described in more detail in the following sections.

2.1 Increase energy awareness of Tenants

Private households often lack awareness of their patterns of energy consumption in the residential environment.

The potential for savings is huge, i.e. user behaviour (positive and negative) can make a substantial difference. Research by the World Business Council for Sustainable Development's "Energy Efficiency in Buildings" project found that "wasteful behaviour can add one-third to a building's designed energy performance, while conservation behavior can save a third. Wasteful behaviour uses twice as much energy as the minimum that can be achieved"[5].

There is a clear need for better information to be provided to tenants about their energy consumption to help them save energy. Surveys of social housing tenants carried out within BECA precursor projects showed a widespread need for further knowledge both of actual use of electrical, gas and/or hot water energy in their homes and of the most effective ways to save energy. In particular, there was little understanding of how relatively minor changes in energy related behaviour can impact on the environment and on household finances[6].

However, it appears unlikely that this information can be effectively provided by simple promotional and educational techniques. For example, results from the UK's Energy Demand Research Project[7] suggest that hoped for results from pure information campaigns (not tailored to individual household consumption) are not materialising. Efficiency information and advice was given to over 20,000 households, but results have not shown any significant differences in energy consumption due to the advice. Given information needs, it has to be concluded that **information techniques which leave users / readers to perform a substantial transfer of knowledge to their individual situation are unlikely to be effective**, i.e. not change behaviour to any significant degree.

This explains the essential role of smart metering systems which provide real-time, personalised information upon which consumers can respond directly by adapting their energy consumption behaviour. Although the evidence base is not fully conclusive yet, findings from research so far suggest that real-time feedback to users will lead to “reductions of 5-25% of energy consumption“[89].

BECA Energy Awareness Services provide examples of this approach. BECA services provide direct, timely and comprehensible feedback on energy (heating, electricity) and water consumption. The tenants have access to EAS through a web-based platform which allows them to quickly and easily obtain consumption information at monthly, daily or even shorter time-intervals. The application enables tenants to find out quickly whether their consumption is to be judged as high or not.

The BECA approach takes full account of research findings suggesting that feedback on energy consumption is more likely to impact on tenant behaviour if tenants are enabled to easily understand real time displays. One way of using feedback is by making timely "historical" comparisons. Historical comparison, e.g. today with yesterday, can be useful for residents, provided behavioural and other reasons for differences in energy use in the two time periods can be identified by the tenant. This requirement for impact, that the tenant understand differences, can most easily be met for electricity, provided this is used for slowly changing requirements such as lighting (but avoid summer-winter comparison), cooking or washing.

Making sense of comparisons over time is more difficult for heating and cooling energy because of large variation in external parameters. A major source of variation in demand for heating or cooling energy is of course change in the weather. From one day to the next ambient outside temperature may rise or fall by many degrees and the energy requirement double or halve. Such variation makes it difficult for end-users (tenants) to properly interpret historical data in order to inform their energy behaviour.

One approach to address this problem is by comparing the same month of one year to the next year – but year-to-year variation is still considerable. It is better to use comparison data which has been automatically corrected for changes in the weather (ambient outside temperature change); this is easily possibly using established statistical methods.

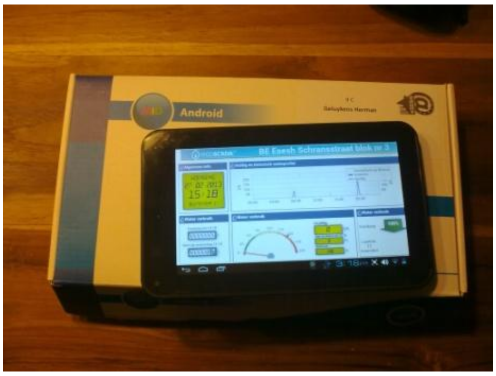
Results from BECA and the precursor project indicate that social housing tenants tend to be satisfied with displays of own electricity consumption provided over the Internet. This corresponds to other smart metering projects in the residential sector[10], where display devices (particularly wall panel displays and – for those with access – web portals) were found to be more popular than paper feedback.

Against this background, BECA solutions put most focus on historic feedback, making the comparison maximally effective by shortening the comparison time frame down from annual to the month or day, and correcting for known influences on consumption variability to ensure the validity of the comparison.

The picture above shows the display used by the BECA awareness service deployed in the city of **Örebro**. On the left-hand scale total monthly cost for consumption (water) is shown in Swedish currency values throughout the year.

At the eSESH site in **Westerlo**, all tenants have been equipped with a small tablet computer and Internet access. Every time the tablet is switched on, it displays the current consumption data before switching to the interactive mode. This feature enabled discussion between tenants, as they took their tablet to their neighbours to compare consumptions. The decision to run the service on a tablet rather than (only) via the Web was taken after preparatory investigation had found that most tenants did not have Internet access.

But there is also a further argument for using a computer gadget that end users will find desirable: The approach goes some way towards "taking the technology from something consumers might feel they need to facilitate a service or solution, towards objects that customers will desire, at least in combination with an energy efficiency or demand response service, but even because of the direct interaction experience it can provide or its aesthetic desirability"[11].

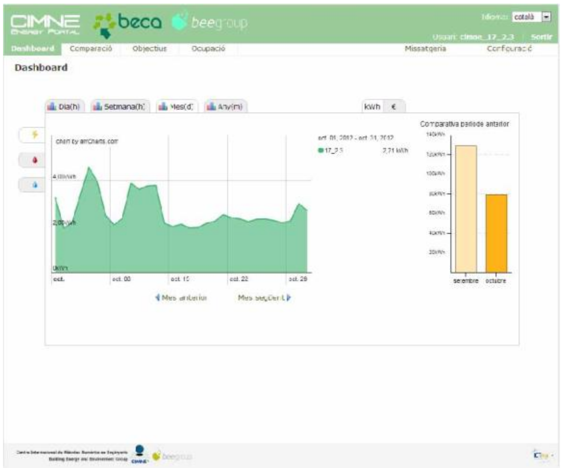


This application area has also been piloted at (and in eSESH sites Catalonia, Extremadura, Frankfurt, Karlsruhe, Linz, Moulins, North Italy and Solingen).

2.2 Enable tenants to manage their energy consumption in smart and efficient ways

The previous section discussed the fact that private households often lack awareness of their patterns of energy consumption in the residential environment. Information and communication technologies such as smart meters can help improve the information supply about energy consumption, e.g. through provision of real-time feedback.

The challenge now is to translate improved personal awareness about energy consumption into changes in behaviour, leading to better efficiency. **A meter which is not acted upon, or even not read, will save no energy whatsoever**.



Especially when submetering devices are installed, customers can follow real-time energy consumption in specific areas, and adapt their behaviour accordingly. In addition, smart power strips can decrease the electricity consumption of devices being shut down or in a standby mode.

Customers can be won to adapt their energy consumption patterns so to avoid peak consumption hours, thereby contributing to what is called **peak shaving** and **load shedding**. Of course, shifting energy consumption from peak to off-peak hours (e.g. night time) will only appeal to tenants if they are rewarded with some kind of incentives. For example, the price of electricity can be lower during off-peak consumption hours.

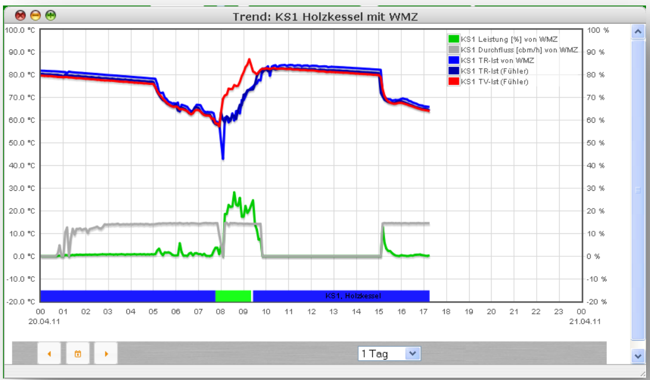
At the eSESH site in **Linz**, personalised energy management is taken one step further by offering the services for tenants in the form of an iPhone application. This application is able to adjust temperatures and even to switch-off of special adaptor plugs on the go.

In **Angers**, electricity utility Voltalis developed a load shedding service for which purpose the “Bluepod”, a small communicating box linked to the distribution board, was developed and installed in every dwelling. It measures and modulates the power consumption in real time, linked to a centrally controlled smart grid software: In times of peak consumption, the BluePod automatically cuts off connected electrical appliances for up to 30 minutes (usually 5-10 minutes). Tenants can select devices to connect to the BluePod, such as electric heaters, washing machines, dishwashers or freezers. The device also monitors the maximum load of the total dwelling, which can allow tenants to switch to a cheaper tariff. Tenants also benefit from vouchers they receive at the end of the year to compensate them for loadshifting. The service is made possible through a contract Voltalis has with the grid operator, which transmits a signal at the start and end of periods of peak usage. This allows Voltalis’s system to automatically switch off appliances in the dwellings connected at exactly those times were loadshifting is most in need.

2.3 Manage use of renewables

Smart metering can be used to integrate the growing number of embedded renewable generators, such as wind and photovoltaic. Smart Metering systems can readily be set up to measure exported power, when the housing unit use less power than it generates. Such systems can also measure the output of the generator and supply this data to the energy company to provide a complete picture of the generator’s performance.

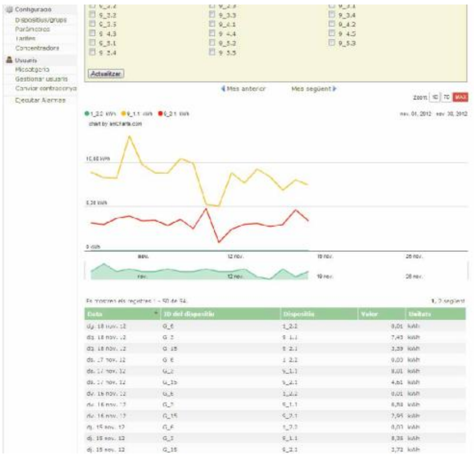
Modern district heating plant appropriate for use in social housing is available fired with renewable energy sources and built as combined heat and power CHP to provide additional, cost-effective power generation. Manufacturers of these and other decentralised energy supply installations like solar panels already provide ICT components for systems monitoring and control – products are equipped with up-to-date measurement and control devices and local screens which show current operation parameters.



This basic infrastructure next has to be taken forward towards integration into automatic evaluation and information feedback to operators for continuous system optimisation.

At two BECA sites, housing providers have worked with suppliers and local utilities to establish the most effective model of supplying district heating combining renewables with local power generation. In doing so, the aim has been to ensure that ICT control systems maintain network stability while providing customers (social housing tenants) with full quality of service.

The screenshot above comes from **Solingen**'s (eSESH) wood pellet heating system, showing data from heat sensors and heat meters. These data are being used in order to optimise the overall heating system, resulting in reduced line losses and a maximised proportion of RES within the system.



The screenshot to left is from the BECA pilot in **Manresa** shows a section of the web-based energy portal to monitor centralised renewable energy systems which are installed in the buildings, in this screenshot: energy produced by the photovoltaic system and the solar panels. Through the use of the portal it is possible to assess and compare the performance of a specified system over winter/ summer and/or it is also possible to check the performance of several systems and then compare the outcomes. The service also provides the Housing Company user with the possibility to identify those systems which are not running at 100% potential and take the necessary actions to mitigate any problems.

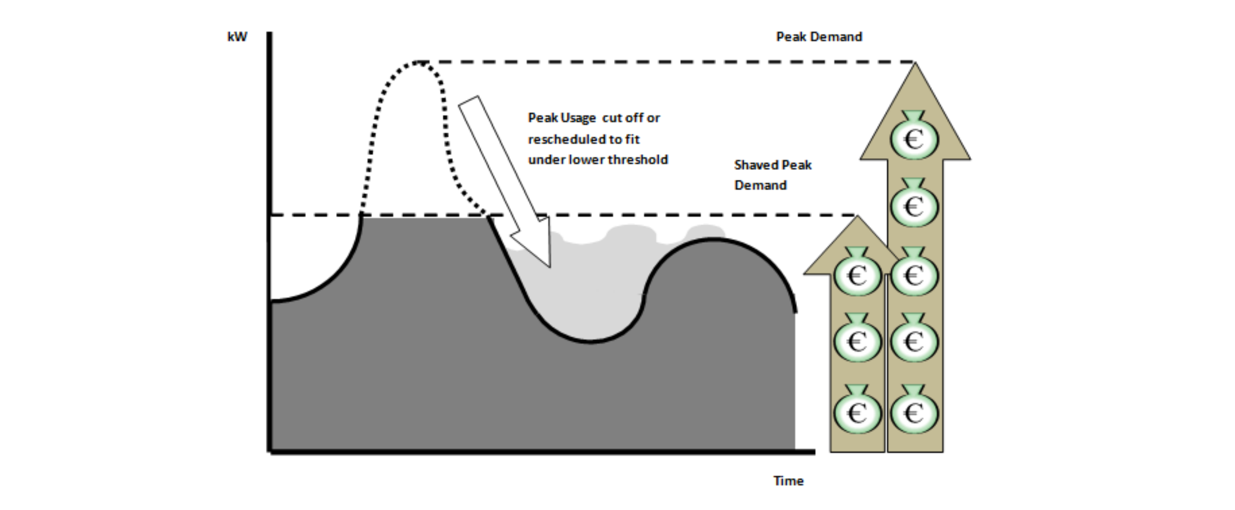
2.4 Enable providers to manage tenants' energy consumption

Smart metering can also enable housing providers and/or utilities to increase energy efficiency by centrally monitoring and managing their customer's energy consumption. This can bring significant benefits in system efficiency and help achieve sizeable energy savings. Based on measured and monitored energy consumption, supply quality (i.e. outages, surges and sags, for instance) and event alarms, the power management system can suggest or initiate schemes for reducing energy consumption.

One application area are district heating systems delivering heated water to buildings, which are known to be more difficult to meter and control than individual dwelling heating. Once smart technologies are in place, these systems can automatically carry out partial switch off – boilers, pumps etc. – depending on demand parameters set by tenants. Tenants can arrange that temperature in individual rooms or throughout the dwelling are reduced during the night and during absence from the dwelling.

Another application area for Centralised energy management is **peak shaving**. This refers to the fact that major waste of energy and unnecessary CO_2 emission continues today through networks meeting very uneven loads, often having fossil fuel power stations take on peaks then running idle (but not without emissions) in the interim. Peaks arise through the very uneven load curve over a typical 24 hour period, with very significant peaks arising from residential behaviour. Any method to shift time of use of energy (e.g. electricity) from peak use periods to times of lower demand makes energy provision more efficient, see figure.

Exhibit 4: Peak shaving to increase energy efficiency12



Energy management in the residential environment can make a contribution to evening the load over time and in particular "shaving" peak consumption. This approach is based on the latency periods, heat storage capabilities or indifferent delivery timing of a number of domestic appliances from fridges to hot water heaters. The performance of heating and cooling devices with good insulation and therefore appreciable temperature maintenance characteristics degrades little over short periods of time. Quality of service to customers (household satisfaction with water temperature, fridge temperature etc.) is unlikely to suffer when these devices are cut off from the electricity supply for periods of many minutes.

As the strongest peaks are unpredictable and typically short term, it is impracticable to rely on the social housing tenant controlling devices so that peak usage is shifted to off-peak time slots; this must be automatic and according to preset rules defined by the housing manager or utility. Such automation means that, through remote controllers in appliances, for instance an AC or electric heating thermostat is set to turn down or off during peak periods. Energy Management Services enabling such dynamic, intelligent peak shaving can thus contribute significantly to energy efficiency in the residential sector.

Housing providers (and possibly utilities) are the main beneficiaries of peak shaving and other kinds of energy management systems described in this report. Introduction of automation relies on acceptance by the tenants. Consumers in general are not opposed to automation per se, since it is often the most convenient and hassle free solution for the tenant. Providers need to make sure, however, that consumers do not feel that they suffer significant disadvantages in terms of comfort or freedom of behaviour.

2.5 Empowering housing providers to better target investment decisions

Social housing providers, in particular if they are in charge of large portfolios of buildings, face a major challenge when they seek to make investments in energy efficiency. The typical question is: Where should we invest our scarce resources so that they yield the highest return in terms of energy savings per Euro spent? Until now, the limited control over energy consumption within buildings made such decisions very difficult.

Smart metering based energy efficiency services can make a huge difference by greatly improving the ability to monitor energy consumption in the residential sector. They provide accurate measurement and transmission of electricity, gas, water or heat consumption data. Through real-time consumption data and aggregation of tenant profiles smart metering based services also allow for a more precise forecast of energy consumption which improves the network management and planning processes.

In BECA, social housing providers participating in the project use smart metering generated data for multiple purposes from day to day maintenance of building heating systems to supporting investment decisions by housing providers and whole regions or nations in respect of insulation and other energy saving measures.

Social housing providers also use metering systems to improve their energy plant maintenance. Data from energy consumption is being used, for example in **Örebro** and **Darmstadt** to prioritise investment in energy saving measures in housing stock; in the eSESH pilot Extremadura, data are being used to target regional investment policy in this respect.

2.6 Examples from BECA and eSESH

BECA presents a complementary set of viable and effective Energy Awareness and Energy Management Services, further described in this section. The approach is based on a modular "toolbox" of components that have been developed in the project, and from which housing providers and related stakeholders can select according to their own specific needs and the priorities of their strategy for energy efficiency.

BECA (and eSESH) services include the following features:

- Automatic digital ("smart") metering for measuring electricity, heat, gas, water consumption;
- Non-invasive load monitoring to provide device-specific consumption data to tenants without per-device metering;
- Visualisation through analysis and presentation of consumption data for access by tenants on home displays, via the Internet and through other media;
- Simple "traffic light" feedback based on weather data adjusted comparison of heating consumption over time (historical feedback);
- Extension / modification of tenant portals in the Internet to present device-level information and meaningful trend information on energy use and add self management functions where appropriate;
- Optimisation and modification of invoicing and tariffs aligned with local legal requirements for allocating costs, particularly of heating and hot water, to building residents;
- Standards based in-building networks and gateways to transmit of consumption data in respect of electricity, gas, heating and hot water;
- Extension of schemes to provide network access to social housing buildings to channel metering information and give social housing tenants online access to consumption data and the wider internet;
- Monitoring the full energy delivery chain to identify investment priorities to optimise energy saving ROI in social housing;
- Aggregating and analysing data on energy use patterns in social housing across a region improve the targeting of public energy saving measures;
- Self-assessment scheme to assess the success of residents of a housing unit in reducing their energy consumption, including input of behavioural parameters by residents themselves;

- Automatic control (switching, dimming, adjusting operating parameters) of major domestic energy devices on timed signals with tariff incentives to even out the load and reduce peak demand with "fixed timing" defined by tariffs.

Two major service categories are distinguished: Energy Awareness Systems (EAS), which provide tenants with greatly enhanced, timely feedback about their energy use, and Energy Management Systems (EMS), enabling end users (tenants), housing providers and/or energy providers to manage energy consumption in smart ways, leading to greater efficiency and lower GHG emissions.

2.6.1 Energy Awareness Systems (EAS)

Energy Awareness Systems (EAS) provide comprehensible feedback on energy consumption, enabling tenants to adapt their energy consumption behaviour.

Advanced **Energy Awareness Systems (EAS)** provide direct, timely and comprehensible feedback on energy consumption, enabling tenants to adapt their energy consumption behaviour.

An EAS visualises energy (heating/cooling, electricity, sometimes also water) consumption in ways which are sufficiently user-friendly to attract tenants to explore their own data. Tenants have access to EAS through a web-based platform which allows them to quickly and easily obtain consumption information at monthly, daily or even shorter time-intervals. Online interaction should not, however, be the only way to approach users. Experience from real-world implementations shows that effectiveness can be increased markedly by combining online with offline modes of interaction.

Depending on the specific implementation context in a given country, city and building complex, a range of different approaches can be applied, as these examples from BECA pilot sites demonstrate:

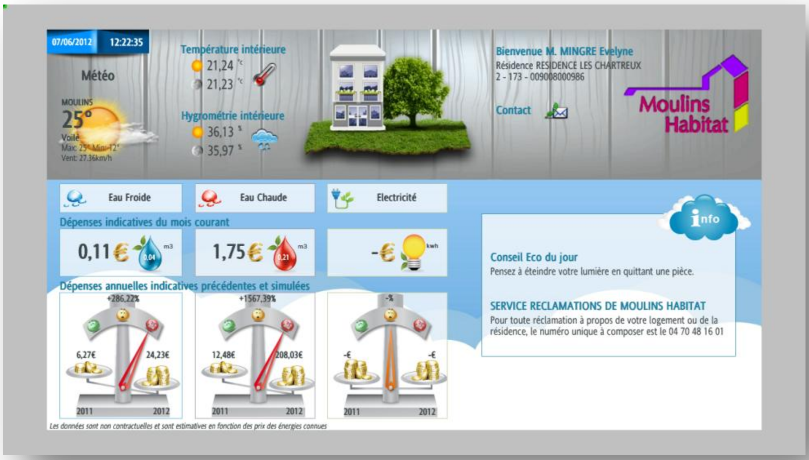
Monitoring: A core element of the EAS facing tenants is a web portal through which (close to) real-time monitoring of energy consumption is made possible. Via sensors installed in the dwelling measuring consumption of heating/cooling, electricity and/or water, data are collected, transferred to a data centre, processed for visualisation and then provided on the tenant portal. Presentation modes used for display on the portal are specific to each pilot site. In Moulins for example, tenants are presented with their monthly and annual consumption patterns in the form of technical units (e.g. kWh, m³), but estimates of the size of the respective bill in € are indicated graphically.

Benchmarking: More specific kinds of information are provided through the online portal as well. One of the options available is benchmarking of energy consumption. Tenants are invited to compare their current consumption patterns to the data from earlier points in time or to data from reference groups, e.g. average over all dwellings in the same building. For example, in Karlsruhe tenants can compare their monthly consumption from one year to another, as the screenshot on the left shows. Visualisation through bar charts and statistics such as percentage decreases/increases are provided. In Linz, a comparison between dwellings is also possible. **Peer comparisons** appear especially suited.

This consists of comparison of household energy consumption levels between similar-sized households. This information may include neighbours within near vicinities or households of similar size. It enables participants to see if they use more or less electricity than their peers, without disclosing confidential data (averages rather than figures for individual neighbour dwellings are being used).

Personalised recommendations and advice: On the websites developed at BECA pilot sites, tenants have access to a personalised area after registering using their personal ID and password. Once in their private area, users are presented with recommendations and advice tailored to their individual consumption profile. This content is generated automatically. In Frankfurt, tenants receive advice through the website (for example, fully opening windows twice a day rather than leaving windows partly open all the day). Users can also download an app on their smart phone through which they are provided with forecasts of their monthly/annual consumption based on most recent data, in addition to a cost estimate. Thus, the application is able to warn the tenant that his bill might get out of hand if he would fail to alter his consumption scheme.

Alerts: The EnergyTIC service can include some alerts that enable the energy manager, the tenant, or both of them, to be informed of unusual gaps of consumptions. The aim of these alerts is to be able to react quickly to malfunctioning such as water leaks, non-adapted behaviours of the tenants or interruption of the data collection. In Catalonia, three levels of alerts have been developed. The first two ones are dedicated to the energy manager in order to react rapidly when a situation of data loss occurs and to be informed when a threshold is exceeded. The third kind of alert is dedicated to the tenant and is combined with adapted tips. When a situation which shows a non-adapted behaviour of the tenant is detected, the tenant is informed of the situation and an adapted tip is proposed to solve the problem. For example, a high heating consumption which is not combined with an increase of the inside temperature can show an abusive opening of the windows. It is advised to the tenant to close the window then.



Self Assessment: A self-assessment tool has been developed for use by tenants. The aim here is to let tenants set their own targets for energy savings to be achieved. Thus, they become active participants of the system rather than just receiving feedback on their energy consumption behaviour. At the BECA site in Catalonia, for example, pilot participants can pick a certain maximum consumption figure (in kWh or Euros) that they want to stay below by the end of the month. A straight line representing the target is automatically displayed in their personal consumption chart displayed online. Daily consumption figures are accumulated and displayed, making it possible for tenants to follow their performance in relation to their self-imposed targets.

Reports: Automatic generation of reports, which can be printed out or downloaded from the portal, has been welcomed by a large proportion of tenants. Reports provide general information on recent developments in energy matters, in addition to the main content made up of individual energy use data and a personalised analysis thereof. In Extremadura, such reports are generated and also posted to tenants each month. The documents feature general information around energy efficiency (building stock, dwellings, practical recommendations for how to reduce energy use) as well as personalised information around monthly energy consumption data. After the end of the pilot duration each tenant will receive a summary report, including an in-depth analysis of their consumer habits and recommendations based on findings from the entire pilot field.

Individual meetings / courses: At the BECA pilot site in Ruse (Bulgaria), a door-to-door approach enabled the project team to explain the system in face-to-face conversation with tenants. For this purpose the project team invited small groups of tenants, explained to them how to use the web portal and the tablet, and gathered feedback including open questions and requests. This approach proved very fruitful, as it appeared to make the innovation less mysterious and more open to user participation. Another objective was to identify and win over tenants who can take the role of ambassadors of the project, i.e. becoming promoters of the system and also transmitters of practical knowledge to those tenants who are hard to reach directly by the housing provider.

Energy Coach: Some BECA pilot sites made use of so-called energy coaches. The coach is to help tenants understand energy efficiency and how it relates to tenants' energy costs, and how these can be reduced most efficiently, making best use of the personalised feedback provided by the EAS services. Activities of the coach include personal discussions; help with using the installed equipment and with the online portal; etc. The energy coach can be solicited by tenants themselves; she also pro-actively approaches tenants herself if there are indications/alerts or of the risk of fuel poverty, i.e. tenants showing difficulties to afford their monthly energy bill.

2.6.2 Energy Management Systems (EMS)

Energy Management Systems (EMS) provide services that enable a decrease of energy consumption based on automatic mechanisms. Smart meters measuring energy consumption in detail are an essential part of EMS. By providing real-time data about the amount of consumed energy and information about consumption time and seasons, smart meters enable system managers to monitor and control energy consumption and evaluate schemes to improve energy efficiency, while minimizing energy costs. EMS can respond to energy demand during peak consumption hours by defining energy saving schemes, such as reducing consumption of heating, ventilation, and air-conditioning systems and lighting or using electricity production systems on site.

As in the case of EAS described above, a range of different approaches can be applied to exploiting the potential of smart meters and related ICTs to make energy management more efficient and effective. Below are some examples from BECA pilot sites:

Optimisation: The optimisation service is based on the measurement of key data in relation with the smooth functioning of the system. Temperatures, flows and different kinds of energy data are measured and transmitted to the property owner. Thus, the property owner has the possibility to analyse the performance of its systems and improve them. In Frankfurt, an ISTA expert analyses the data transmitted from the heating system and makes recommendations to the housing company. The latter can then adapt the settings of its heating system by conveying these recommendations to the maintenance companies (for example, the expert may recommend to switch off the domestic hot water production system overnight, optimise the number of boilers or balance the hydraulic network according to the needs).

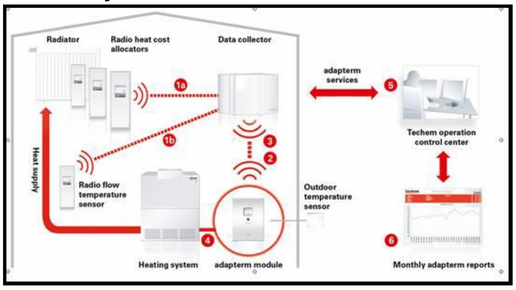
The optimisation service is also used at the dwelling level. Load management means that providers are able to offer their customers a contract allowing the energy company to remotely adjust the customer's load. For example, the energy company can remotely raise the set point for an air conditioning thermostat in the customer's property. Although the customer will not notice much difference, the net reduction in the load can be enough to keep reserve capacity at safe levels or even prevent a collapse of the system and reduce costs.

The energy company can, in turn, pass these savings to the customer. Trials have shown that much of this reduction is sustainable.

The measurement of key data in the dwelling can be supervised and the property owner can intervene and change the parameters of the heating system or help the tenant to optimise his energy consumptions. Besides, as is the case in some BECA pilot sites, the tenant himself can manage his devices thanks to specific devices or through the portal. In Solingen for example, the tenants can change the heating times of their dwelling directly on the web portal. Thus, they can manage the system thanks to an automatic mechanism. In Linz, the optimisation at the dwelling level was realised through adaptor plugs that tenants used in order to manage the switching on and switching off of their devices.

In Angers, the electricity supplier Voltalis developed a load shedding service through the use of the “Bluepod”, a small communicating box linked to the distribution board (see picture). It measures and modulates the power consumption in real time, linked to a centrally controlled smart grid software: In times of peak consumption, the BluePod is able to turn off connected electrical appliances for up to 30 minutes. The service helps Voltalis to contribute to network balancing, lowering customers’ energy bill and reduction of CO_2 emissions.

Early Default and Maintenance Management: The Energy Management Service can include a system of early default and maintenance management. The aim of this option is to take benefit of the service to carry out a surveillance of the systems and to be able to react and solve the problems more rapidly than before. For an example, see the screenshot on the right which is from the Darmstadt BECA site; it shows how the adapterm system works: If abnormal values are identified, they can easily be traced back to their point of origin allowing for quick countermeasures to be taken and / or the overall setting of the heating system to be optimised.



In Catalonia, the central solar system is equipped with a system of early default detection and maintenance management. If the production of the central solar system remains very low or is equal to 0 during three consecutive days, an email is automatically sent to the maintenance company as well as to the service provider. Thus, a revision of the system is possible and the problem can be solved within 3 days.

PART B:
GUIDE FOR REPLICATION

'Part B: Guide for Replication' explains necessary steps to be taken by stakeholders in order to successfully Set Goals, Corporate, Plan, Implement, Monitor & Evaluate and ICT-enabled energy saving services. The relevance of individual steps for individual stakeholders is being highlighted at the beginning of the given section. Key stakeholders are Social Housing Providers, Local and City Councils, IT-Service and Measurement Providers, Energy Provider, Social Services, Tenants and Policy Makers.

Lessons learnt in ICT-projects BECA and eSESH are provided for each stakeholder at the end of the relevant chapter. Checklists are provided for individual steps.

Goals require thorough review of potential benefits risks of service implementation including the regulatory environment and national and European level. Identification of existing hardware and access to it is needed to define realistic goals.

Cooperation with numerous stakeholders is required to ensure operation of the service and to reduce costs. For instance, measuring cabinets might belong to Third-Parties and depending on the local structure various stakeholders need to be informed of measures to be taken. Since awareness services require tenants to become active communication is key and successful means include the identification of 'champions capable of informing and recruiting actors to use the service.

Planning should begin with defining the scope and focus to ensure communication is transparent. Requirement capture includes functional as much as non-functional items which can be collected, for instance, by the use of focus groups. An important aspect is ensuring data protection. Selection of Use Cases and Process models (provided in the Annex) as well as identifying the best specifications and architecture best suited for the current environment allows for review of individual systems.

Implementation requires clear definition of roles and response plans. While testing the system as such is essential, promotional activities have to start early in order to recruit and train the professionals and tenants operating the systems.

Monitoring and evaluation of the service ensures that the full potential of the system implemented is achieved. This includes analysis of recorded consumption data as well as interviews of users. Standardised methods can be used (e.g. IPMVP). To optimise future exploitation and replication, the business model can be revised.

3 Overview

This chapter introduces the active and relevant stakeholders for whom this guide is designed for. The relevant steps and activities are identified for each stakeholder.

3.1 Stakeholder descriptions

This section identifies eight key stakeholders. In some constellations numerous roles could be played by one party. For instance, in some countries measurement of resource consumption is combined with the energy provision. Hence, the stakeholder definitions focus on the key function it plays in the implementation and operation of BECA services. Each party should check for any role it might play at any point of the project.

Social Housing Provider

The social housing provider is responsible for the buildings the tenants live in. This involves managing the facilities and organising - not necessarily performing - the billing of public space or publicly used commodities.

Local and City Councils

Local and city councils can be the provider of the social housing service. It might also be the party paying for resource consumption (and rent) of tenants receiving societal benefits and / or suffering from energy poverty. In some instances staff could also become a user of the service.

IT-Service Provider

The IT-service provider is responsible for collecting all data from the measurement service provider. This involves responsibility for the full process of the back-end data-stream and allowing tenants and social housing providers two-level access to their data.

Measurement Service Provider

The measurement service provider is responsible for collection of (smart) meter data and making the data of individual meters available to some other party. Usually, the measurement provider owns the meters and charges another party for meters and the services offered.

Energy Provider

The energy provider is the last distributor/agent of the commodity. The commodity sold to the tenant is used by the tenant himself. Usually, the energy provider either issues the bills directly to the tenant or through the social housing provider to the tenant.

Social Services

Social services in context of BECA focus in particular on social workers in touch with the tenants on regular basis. The relationship with the tenant can become a relevant entry point for empowering the tenant in conserving resources.

Tenant

The tenant lives in a single dwelling (or owns it) and is the user of the BECA service. Usually, he pays for the rent and all commodity bills but might also receive societal benefits.

Policy Makers

Policy makers are not directly involved in the management of a single project. However, policy makers design incentives and might distribute funding which might smoothen and push energy efficiency measures such as BECA.

3.2 Guide for Stakeholders

To avoid repetition of content and to keep the guide compact the relevance of all sections is weighted for any given stakeholder. This design ensures that all stakeholders use the same checklists and set of instructions in order to avoid misunderstandings and confusion about the current progress of planning, implementation and evaluation.

For each section and stakeholder a colour indicates the relevance. The darker the colour of the cell the more relevant this section is for the given stakeholder. The table below displays the relevance of chapters. In each chapter a similar table provides the detail for each section within the chapter.

***Reading relevance scale**: Darker colour equals higher chapter relevance for the specified target group.*

Section	Title	Social Housing	City Council	IT-provider	Measurement	Energy provider	Social Services	Tenants	Policy Maker
5	***Setting up the project***								
5.1	Set goals								
5.2	Cooperate: Achieving stakeholder buy-in								
5.3	Plan: Designing the eSESH implementation								
6	***Implement the service***								
6.1	Roles confirmation and contract signature								
6.2	Test the system								
6.3	Staff training								
6.4	Promotional activities and user recruitment								
7	***Monitor & evaluate***								
7.1	Monitoring and troubleshooting								
7.2	Evaluation of impacts on energy efficiency and GHG emissions								
7.3	Business case modelling and cost-benefit analysis								
7.4	The future								
7.5	Lessons learned & Recommendations								

4 Setting up your project

This section comprises the first three steps of the implementation process, namely goal-setting, stakeholder buy-in and project planning.

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

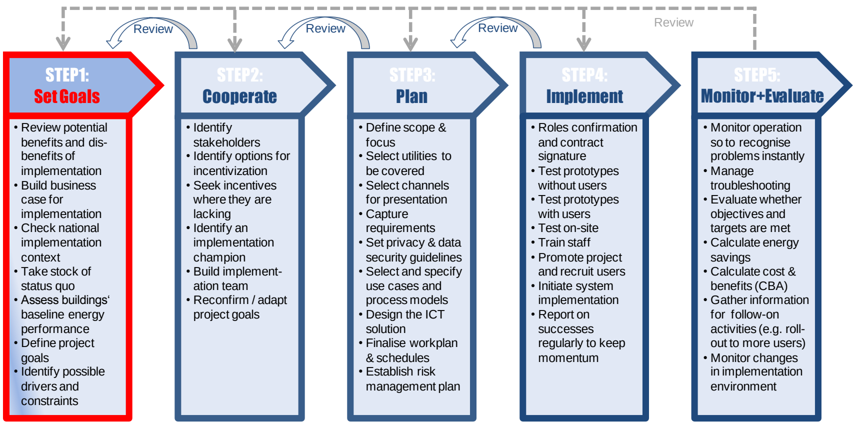
Section	Title	Social Housing	City Council	IT-provider	Measurement	Energy provider	Social Services	Tenants	Policy Maker
5	***Setting up the project***								
5.1	**Set goals**								
5.1.1	Review potential benefits and downsides of eSESH implementation: The business case								
5.1.2	The national regulatory environment								
5.1.3	The status quo: Check what's there already								
5.1.4	Definition of goals								
5.1.5	Identification of drivers and constraints								
5.1.6	Lessons learned & Recommendations								
5.2	**Cooperate: Achieving stakeholder buy-in**								
5.2.1	Identifying all key stakeholders of relevance to the implementation project								
5.2.2	Incentivise stakeholders								
5.2.3	Build implementation team / identify champions								
5.2.4	Reconfirm and adapt project goals								
5.2.5	Lessons learned & Recommendations								
5.3	**Plan: Designing the eSESH implementation**								
5.3.1	Defining scope and focus								
5.3.2	Requirement capture								
5.3.3	Guidelines for privacy and data protection								
5.3.4	Designing Use Cases and Process Models								
5.3.5	Design the ICT solution: Systems architecture, specification and system components								
5.3.6	Scheduling and risk management plan								
5.3.7	Lessons learned & Recommendations								

4.1 Set goals

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

The first step at the outset of an implementation project should always be agreement on the **overall goal of the intervention**. While improved energy efficiency is obviously the overarching goal, there are several ways to achieve this and the kind of intervention to be chosen also depends on the regulatory environment and the actors to be involved.



The project should start with a **review of the potential benefits and downsides** of implementing smart metering based services for a given stock of social housing. Based on best practice and available research evidence, it should be possible to make a general estimate about the costs and potential benefits to be derived from implementing, which will help build a **case for investing** in BECA service implementation.

Any decision about implementation of smart metering related innovations in the social housing sector has to take full account of the **national and regional/local regulatory environment**. A number of Member State governments have developed policy initiatives for the support of smart technologies for energy efficiency in the residential sector. In many cases, support programmes and incentive schemes have been set up. Investors need to fully understand the national implementation context before embarking on a smart metering project.

The national and local environment will also influence the **main options which are available for action** within the social housing sector, as well as the **main drivers and constraints** to be expected.

The project at this stage will also want to **take stock of what is in place already** in terms of infrastructure for metering and energy management. All of the above will enable the project initiators to **define a number of goals** of their endeavour. At this stage of the project, goals need to be general rather than specific, in order not to predetermine key features of the project before all key stakeholders have come on board.

4.1.1 Review potential benefits and downsides of BECA implementation: The business case

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

For the purpose of reviewing the benefits and downsides to be expected from an implementation of BECA services, the overview of smart metering functionalities and applications of interest for the social housing sector, provided in the present document (Chapters 1 to **Fehler! Verweisquelle konnte nicht gefunden werden.**), can be used.

While some housing providers will want to roll-out smart metering within their housing stock to comply with the recommendations by national policy-makers (see following chapter), others will want a well elaborated business case for justifying any investment in BECA service implementation. Methods for calculating a cost-benefit analysis are explained in Chapter 6.3 below. For ex-ante calculations, i.e. analyses conducted prior to an implementation, estimates need to be used. These can be derived from cases of good practice reported in the literature.

The checklist below allows you to check which of the potential benefits expected from BECA implementation are of relevance to your organisation. This exercise will help you design the implementation in a way which is likely to maximize those benefits that count most for you.

Checklist 1: BECA benefits of relevance to your organisation

Which of these potential benefits are relevant for your organisation?	very relevant	somewhat relevant
Own cost savings	☐	☐
Cost saving for customers (tenants)	☐	☐
Reducing emissions of green house gases (GHG)	☐	☐
Developing the organisation's profile as committed to sustainability	☐	☐
Managing energy networks/grids better by shifting or reducing energy consumption, e.g. reducing peak demand levels (peak shaving)	☐	☐
Gaining better knowledge about tenants' energy consumption patterns in order to identify dwellings in need of targeted advice	☐	☐
Enabling provision of more adequate, personalised recommendations on saving energy to tenants	☐	☐
Being better able to spot energy system failures and any other kind of critical issues (in real time)	☐	☐
Developing tenants' understanding and feeling of responsibility for energy consumption and how best to make it more efficient	☐	☐
Offering best possible service to customers (tenants)	☐	☐
Improving customer relationship management (CRM), e.g. being able to offer additional services tailored closely to customer's preferences and needs	☐	☐
Sending customers more accurate bills based on actual consumption data rather than on estimates or average values	☐	☐
Offering energy consumption feedback through a range of channels, e.g. the Internet, in-home-displays, mobile devices, paper-based billing etc.	☐	☐
Preparing investments in energy efficiency where they are most cost-efficient	☐	☐
Integration of renewables	☐	☐
Enabling introduction of dynamic tariffs as a means to reward customers for shifting energy use to off-peak times	☐	☐
Improving load management by enabling remote adjustment of the customer's load (e.g. briefly switching off electrical heating devices at peak times), and passing on some of the savings made possible to customers	☐	☐

4.1.2 The national regulatory environment

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

The EU's Member States have started to set up a range of regulatory measures and policy initiatives to boost take-up of smart metering for the purpose of increasing energy efficiency, especially in the building market. Knowledge of the provisions and upcoming regulatory changes in your country are required in order to take well-informed decisions concerning BECA implementation.

The national implementation context

There is large variation across Europe regarding the government support initiatives for implementation of smart metering in the residential sector receives. The extent to which smart metering is actually rolled out is also strikingly different across Member States.

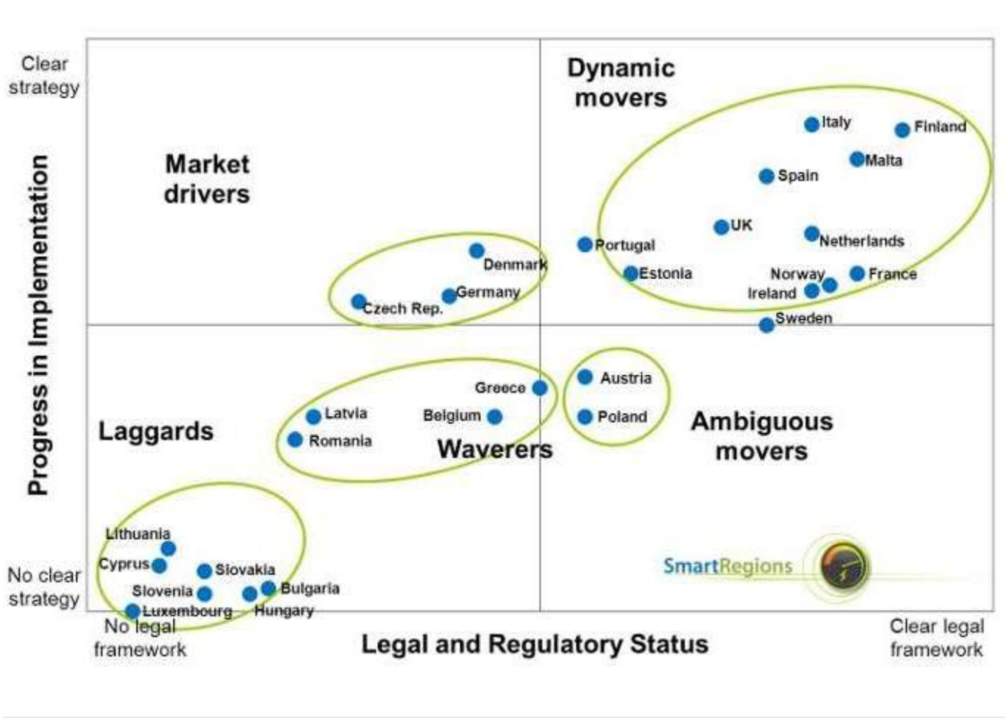
A cross-country review of the situation in autumn 2012, carried out by the SmartRegions project[13], came to the conclusion that "progress has been strongest in the countries with a significant regulatory push". The study grouped Member States into five categories according to progress in smart meter implementation and support received from the legal and regulatory environment (see Exhibit 5):

- **Dynamic Movers** are most advanced, and include Italy, Spain and France.
- **Market Drivers** are lagging behind in terms of implementation of the legal and regulatory framework, but have made good progress in roll-out. This group includes Germany.
- **Ambiguous Movers** lag behind in terms of roll-out

Many of the so-called dynamic movers have defined very ambitious rollout plans. In addition, most of these countries have formally agreed on minimal requirements smart meters have to meet, something which is still missing in most other countries. Countries classified as market drivers have achieved only moderate progress so far.

Many countries suffer from a large degree of scepticism, especially on the part of consumer advocates and data privacy activists.

Exhibit 5: The European landscape for implementation[14]



EU Directives and their impact at national level[15]

The European Union has implemented a number of **Directives** dealing with energy efficiency in the building sector. Directives are legislative acts which require Member States to achieve a particular result *without* dictating the means of achieving that result, i.e. it is left to national governments to translate a directive's objectives into legislation and other policy initiatives at national level.

Directive 2002/91/EC on the energy performance of buildings states that "demand management of energy is an important tool enabling the Community to influence the global energy market and hence the security of energy supply in the medium and long term". The Directive does not yet make reference to smart metering technologies, but prepares the ground for doing so by calling for a concerted effort to limit energy consumption in this sector.

Given that the share of buildings in total energy consumption is likely to increase and that meeting the EU's target of reducing its estimated energy consumption for 2020 by 20% remains highly ambitious, a follow-up Directive was adopted in 2010 (**Directive 2010/31/EU on the energy performance of buildings**). It calls for standardisation of methodologies in seeking improvements in energy efficiency. Still, the basis of methodologies to calculate energy performance of buildings remains in the hands of national and regional bodies. Member States are required to put in place, in compliance with their chosen calculation methodology, minimum requirements for energy performance in order to achieve cost-optimal levels. When setting requirements, Member States may differentiate between new and existing buildings and between different categories of buildings. Furthermore, "Member States shall encourage the introduction of intelligent metering systems whenever a building is constructed or undergoes major renovation". Public authorities are asked to lead by example including early adoption of efficiency measures as well as to participate in performance certificate schemes displaying these to the public. Regular adjustments of installations for optimal performance are to be accomplished together with reduced costs and transparency to users and owners. The relevance of local authorities is highlighted in the context of legislation and implementation. The Directive had to be transposed into Member State legislation by July 2012.

On 25 October 2012 the EU, after intense debate between Member States, adopted **Directive 2012/27/EU on energy efficiency**. It established a “common framework of measures for the promotion of energy efficiency within the Union in order to ensure the achievement of the Union’s 2020 20% headline target on energy efficiency and to pave the way for further energy efficiency improvements beyond that date”.

Most importantly, **energy providers** will be required to achieve 1.5% energy savings every year among their final clients. The Directive’s exact provisions concerning this measure are complex, but they boil down to energy providers being forced to step up their efforts to make their customers save energy.

The second key measure is of particular relevance to **state-owned housing providers**. The public sector is to take a leading role in energy efficiency renovation as to set the example to the whole building sector. Binding targets have been set only for central government-owned buildings, however, and not for buildings owned by regional or municipal authorities. The number of central government-owned buildings differs strongly across Member States.

Concerning **smart meters**, the Directive includes provisions that Member States need to ensure that, “in so far as it is technically possible and financially reasonable”, final customers for electricity, natural gas, district heating, district cooling and domestic hot water are provided with “competitively-priced individual meters that accurately reflect the final customer's actual energy consumption and that provide information on actual time of use”, i.e. smart meters. In new buildings or when buildings undergo major renovations, such competitively-priced individual meters will always have to be provided. In multi-apartment buildings with a central heating/cooling source or supplied from a district heating network or from a central source serving multiple buildings, individual consumption meters will have to be installed by January 2017 to measure consumption for each unit “where technically feasible and cost efficient”. Measures also need to be taken to ensure, by January 2015, that billing information is accurate and based on *actual consumption*, in order to enable final customers to regulate their own energy consumption, and that it is provided at least twice a year, or quarterly, upon request. Energy providers will be required to inform customers, “in a clear and understandable manner”, about sources of information such as consumer advice centres, energy agencies or similar institutions, “where they can obtain advice on available energy efficiency measures, benchmark profiles for their energy consumption and technical specifications of energy-using appliances that could help to reduce energy consumption”.

Each country had to present national energy efficiency plans including indicative targets before **April 2013**. If the European Commission estimates that those are insufficient to meet the EU's overall 2020 goal, then it can request Member States to re-assess their plans. In **early 2014**, the European Commission will review the progress towards the 20% energy-efficiency target, report on it and assess whether further measures, such as binding targets, are needed.

Earlier in 2012, the Commission had already adopted a **Recommendation on preparations for the roll-out of smart metering systems**. The rollout is foreseen by 2020 subject to an economic assessment of costs and benefits. This assessment had to be carried out by each Member State by September 2012.

In sum, what this means is that there is at the moment some degree of uncertainty about the kind of measures national governments will take on the energy efficiency front. It can be expected that conditions for implementation of smart metering will continue to differ strongly between Member States, and that they will change considerably over the coming years. Stakeholders interested in implementation of smart metering in the residential building sector need to follow closely national policy-making in the area.

Overview of developments in EU Member States

An overview of the situation in each EU Member State regarding the regulatory and legal situation and the actual implementation of smart metering on the ground, as of autumn 2012, is available from the SmartRegions project[16]. It is reproduced in abridged format in the Annex of the present document. To jump there click on the respective country in the table below.

Exhibit 6: Smart metering landscape in Europe

Country	Country	Country
Austria	Belgium	Bulgaria
Cyprus	Czech Republic	Denmark
Estonia	Finland	France
Germany	Greece	Hungary
Ireland	Italy	Latvia
Lithuania	Luxembourg	Malta
Netherlands	Poland	Portugal
Romania	Slovakia	Slovenia
Spain	Sweden	UK

4.1.3 The status quo: Check what's there already

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

Before planning your own implementation project, you will need to check the current status quo in terms of energy systems and energy efficiency infrastructures and initiatives. What metering systems, wired or wireless infrastructure, etc. are in place?

The same goes for activities already completed or started concerning awareness raising, energy saving advice, etc. – ranging from information provided via posters or publications to the use of an energy coach and cooperation with local providers of advice and counselling to households at risk of poverty.

Taking stock will allow you to incorporate existing infrastructure as good as possible, and to build upon up-and-running activities wherever possible. It will also enable you to identify key individuals and stakeholder organisations who should be involved in one or the other way in BECA implementation. In this context, it is not only important to identify whether certain infrastructure is already in place but also who has the control / ownership. The need for duplicating equipment can be a major hit to the cost-efficiency of a business model and it might even be in your interest to consider offering payments (e.g. fees or other involvement) for existing infrastructure / services.

Use the checklist below for the stock-taking exercise. Remember that each building in your portfolio might have different characteristics, for which reason you should distinguish between each of them.

Checklist 2: Status quo assessment – What's there already?

Existing infrastructure and practices	Ownership / Controlled by	building 1	building ...
Meter infrastructure			

Existing infrastructure and practices	Ownership / Controlled by	building 1	building ...
In-home displays			
Broadband Internet access			
Tenant portal or similar on the Internet			
Telecommunications infrastructure (e.g. cabling throughout the buildings)			
Public online access (information kiosk or similar)			
Own energy generation capabilities			
Renewable energy generation			
Energy coaches or similar			
In-house expertise in advanced metering etc.			
Informative billing			
Programme for awareness raising on energy saving			
Advice & education measures targeting high-consumption households			
Municipal initiatives on climate action			
Tenant association or similar			
Dynamic tariffs (e.g. electricity rates lower during off-peak times)			

The building type and the structure in place determines which efficiency activity is of particular relevance and which issues need to be pointed out to the tenants in order to maximise their own impact. This information is also of relevance for evaluating the impact as meta data carries the ability to cluster information and sources.

The following checklist can be used to collect key information and it is advice to cluster the buildings in a second step.

Checklist 3: Status quo assessment – Building type

Building Type	building 1	building 2	building ...
Ownership / Controlled by			
Year of construction			
Year of last major refurbishment			
Storeys			
Dwellings (number)			
Residents (number)			
Total dwelling surface in m^2			
Average m^2 per dwelling			
Total community space surface in m^2			
Average m^2 of community space per dwelling			
Basement			
Roof type			
Total m^2 of outside surface			
Average m^2 of outside surface per dwelling			
Insulation material			
U-value walls			

Building Type	building 1	building 2	building ...
U-value windows			
Heating source			
Heat production (power)			
Heating Efficiency (output)			
Warm water source			

4.1.4 Definition of goals

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

After taking stock of the status quo in terms of energy efficiency across one or a portfolio of buildings, the next thing is an assessment of the **baseline energy performance**. Assessing energy performance involves looking at how energy is used in existing buildings, which will allow you to identify priority opportunities to improve energy efficiency. Surprisingly, housing providers' knowledge of their buildings' energy performance still tends to be very limited: Partly because any such investments are considered as a risk. A range of tools are available today which can help building managers to get the full picture of their building's current energy consumption patterns.

Setting goals means looking at the potential savings you would like to achieve by implementing BECA. For existing buildings, these goals can be based on the results of the baseline energy performance assessment and estimates about the impact of your investment in BECA, as discussed in the present document. For new buildings, goals can be based on results from energy performance projection tools, compared against your portfolio of existing buildings (and/or sector best practice).

It is necessary to determine appropriate scope for goal-setting, e.g. whole buildings, parts of buildings or categories of users (e.g. when high-consumption tenants are to be targeted).

Establishing energy performance targets for each building allows housing providers, possibly in cooperation with energy providers, to clearly articulate to tenants and other key stakeholders what results you expect from energy efficiency investments in each building. This will help maintain momentum for energy management activities, guide daily decision-making, and track and measure progress which is also necessary to assess and avoid risks.

Collecting this knowledge also enables you to fund higher efficiency standards by, for instance, involving construction companies. Contracting (future) energy savings would be an incentive to ensure high quality and to respond to procurements not only with the cheapest option available but higher quality / efficiency. If the new buildings – compared with the current efficiency level – consume less the construction companies might receive fees or other forms of payments either from the housing company or tenants. Such concepts also reduce the risk of building success, price developments and other exogenous developments.

In many cases, goals for improving energy efficiency through BECA will be part of a larger goal that incorporates multiple energy efficiency activities across the housing stock. New buildings present a special case, as here investments in EAS and EMS need to be considered in the context of other major decisions and trade-offs concerning energy efficiency and cost implications.

4.1.5 Identification of drivers and constraints

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

The final element of the first phase in the implementation project involves identification of the main drivers and constraints which can be expected to have an impact on the project's success. Drivers are trends and developments affecting external conditions (e.g. increasing energy prices) or in conditions internal to the organisation (e.g. increasing company focus on investments in sustainability).

Assessment of the most important drivers and constraints at this stage in the project will enable you to properly plan the second phase in the implementation, i.e. identifying all key stakeholders and obtaining their buy-in (see next chapter).

Typical drivers include:

- **Political support** at national or local/regional level, creating a strong momentum for exploiting smart metering's potential for improving energy efficiency;
- **Financial support** in the form of subsidies being paid to housing providers implementing smart meters and/or related services in residential buildings;
- **Consumers voicing increasing demand** for being better able to explore their own energy consumption and to cost-control their energy bill;
- **Increasingly wide-spread concern for the environment**, particularly for preventing severe climate change, which can lead consumers to take a stronger interest in saving energy;
- **Strong consumer interest** in ICT applications that give them more control over their daily life combined with automation of routine processes, as discussed widely e.g. under the term "smart homes".

Types of constraints can include:

- **Investment strategies focussing on the short-term**, resulting in a prioritisation of investments that yield a return in a short period of time over investments yielding a much larger return but only in the longer term;
- **Financial constraints** and budget squeezes, making it more difficult to justify fast roll-out of smart metering to all or a large proportion of dwellings;
- **Uncertainty about upcoming regulation**, e.g. on smart meter roll-out, informative billing, mandatory energy savings, etc. Perceived uncertainty is likely to result in reluctance to make large investments in infrastructure;
- Concerns about **data privacy** among customers (tenants). Such concerns have already lead in 2009 to the failure of the plan of the Dutch government to make smart meters compulsory in every residential building by 2013, after intense campaigning by consumer protection groups and privacy advocates (see section 4.3.3);
- Concerns about **data security** threats posed by computer viruses and similar attacks. While consumers have learned to live with the risk of infected home computers, security experts have pointed out that smart meters are also potentially vulnerable to hacking, manipulation, spying and unwanted telemarketing[17];
- **Lack of cooperation** by utilities, measurement service providers and other stakeholders who have a key role in the energy supply chain (see section 4.2.2).

Actual drivers and facilitators at work at a given site for implementation will depend strongly on the implementation context and the local environment for investments in energy efficiency and roll-out of customer-facing applications. Use Checklist 4 to note down those drivers and constraints which are, potentially at least, of most relevance to the success of your project. (The table has been filled with some examples; modify or delete these as appropriate)

Checklist 4: Drivers and constraints to BECA implementation

Potential drivers / constraints	Contingencies	Relevance	Implications
Political support at local level	e.g. Next elections e.g. Pressure from local business community	high⇔low □□□□□	List here
Financial support	e.g. Local/regional strategy on energy efficient buildings	high⇔low □□□□□	List here
Consumers voice increasing demand for being able to cut their energy bills	e.g. Development of the public debate about fuel poverty e.g. Sharply increasing energy prices	high⇔low □□□□□	List here
Increasing concern about climate change and carbon footprints	e.g. Any new climate-related natural disasters	high⇔low □□□□□	List here
Strong consumer interest in “smart homes”	e.g. New devices and killer applications from leading suppliers on consumer market	high⇔low □□□□□	List here
Any other potential drivers	...	high⇔low □□□□□	List here
Investment strategies focussing on the short-term	e.g. Shift in strategic focus following change in ownership	high⇔low □□□□□	List here
Financial constraints and budget squeezes	e.g. Development of economic crisis in Euro area	high⇔low □□□□□	List here
Uncertainty about upcoming regulation	e.g. Change of government e.g. Policy change resulting from failure of climate policy so far	high⇔low □□□□□	List here
Concerns about data privacy	e.g. Major incidence of privacy violation reported in the media	high⇔low □□□□□	List here
Concerns about data security	e.g. Major incidence of security leaks reported in the media	high⇔low □□□□□	List here
Lack of cooperation from key stakeholders	e.g. Shift in strategic focus following change in ownership e.g. Change of top management	high⇔low □□□□□	List here
Any other potential constraints	...	high⇔low □□□□□	List here

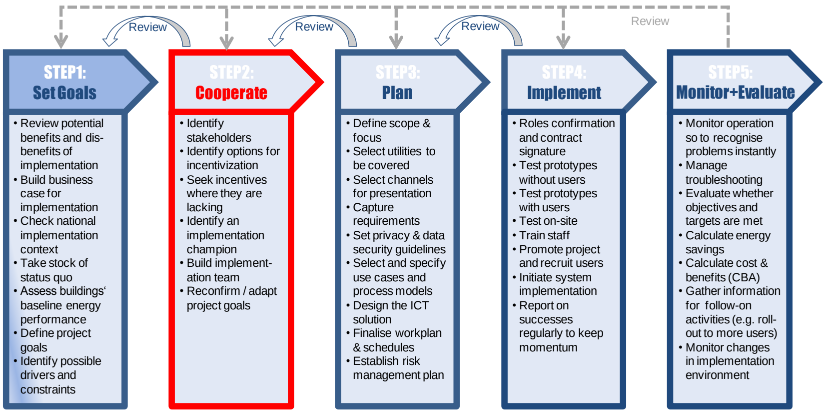
Knowing the main drivers and potential constraints for your smart metering project will make it easier for you to identify and select the right partners /stakeholders for participation in the project and to make sure that they perceive sufficient incentives to fully commit to the endeavour, as will be discussed in the next section.

4.2 Cooperate: Achieving stakeholder buy-in

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

Obtaining **buy-in and active support from key stakeholders** is of essential importance for any project for exploiting the potential of smart metering for improving energy efficiency in social housing. There are plenty of examples of energy efficiency services that have been introduced but met with limited success because the actors involved in the service offer were not sufficient or did not fit the purpose. For this reason it is necessary to carefully assess the local implementation context before the project's goals, predefined in the first phase (see previous chapter), can be adapted as adequate and then confirmed. The objective of this project phase is therefore to achieve strong consensus across a broad group of stakeholders about a set of well-defined goals for the intervention.



This chapter seeks to help with **identification of all stakeholders** who need to be involved in one way or the other in a project for exploiting smart metering's potential for energy efficiency. Some of these stakeholders may act as **implementation champions**, i.e. persons or organisations who are likely to be committed to the project goals and who are in a position to exert a strong influence over other stakeholders who may need to be convinced.

We put special emphasis below on the issue of **incentivisation of key stakeholders**, i.e. the need to identify incentive structures and build incentives where motivation is lacking for all key stakeholders. It may also be required to adapt the project's scope and focus if some stakeholders cannot be brought on board.

Next follows the set-up of an **implementation team** consisting of committed staff from all main stakeholder groups.

This group will then be in a position to **reconfirm the project goals** as set initially by the initiator, and to adapt them in light of the various stakeholder priorities, motivations and policies.

4.2.1 Identifying all key stakeholders of relevance to the implementation project

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

The main **roles** in 'market' for energy efficiency in the residential sector in Europe are:

- **Customers = Tenants**: The tenant lives in a single dwelling (either owner-occupied or rented) and is the target user of EAS. Typically the tenant pays for the rent and all commodity bills, although in some cases (e.g. welfare recipients in some Member

States) these costs are being borne by the municipality or state. Tenants might be represented by advocacy groups such as tenant associations, in which case the latter should partake in the project as well.

- **Social Housing Provider**: The housing provider is responsible for the buildings the tenants live in. Usually, the provider manages the facilities and organises, but not necessarily performs, the billing of public space or publicly used commodities. Housing companies typically take a leading role in BECA implementation projects.
- **Energy Provider = Utility**: The energy provider is the last distributor/agent of the commodity. The commodity it sells to the tenant is used by the tenant herself. Usually, the energy provider either issues its bills directly to the tenant or through the social housing provider to the tenant. There can be a conflict of interest between utility and housing provider if one of them perceives the other to challenge what it believes should be its own natural dominion.
- **Measurement Service Provider**: The measurement service provider (also called Meter Operator) is responsible for collection of meter data and making the data of individual meters available to some other party. Usually, this organisation owns the meters and charges another party for renting the meters and for services based on them. Exchange of old for smart meters can have a huge impact on the business model of the measurement service provider, which implies it needs to be convinced of the benefits to be derived from BECA implementation.
- **IT-Service Provider**: The IT-service provider is responsible for collecting all data from the measurement service provider. Usually, this provider is responsible for the full process of the back-end data-stream and allowing tenants and social housing providers two-level access to their data. The roles of measurement service provider and IT service provider are often taken on by the same stakeholder organisation.

Possible other roles, sometimes aligned with one of those listed above, include:

- **IT-equipment provider**, e.g. companies offering smart metering devices. The devices are typically supplied to the measurement service provider rather than directly to the housing company or even consumers (tenants).
- **Provider of energy advice**, e.g. agencies specialised in counselling users (both private households and organisations) about how to save energy. For the purpose of providing advice and education, some BECA sites have made use of energy coaches, i.e. individuals who acts as tenants' guide throughout the implementation process, assisting consumers with understanding their consumption behaviour, finding ways to save energy most effectively, and answering any related questions.
- **Social insurance carrier**: In some Member States, not all tenants in state-subsidised housing are responsible for paying their utility bills. Often this role is taken by the public agency responsible for housing assistance / accommodation allowance. Depending on the social security system, it is often the municipality that has to pay for this group's utility bills. In housing portfolios with large shares of tenants living on benefits, the municipality or another public body can therefore be a major stakeholder to be included in the smart meter implementation project.
- **Policy-makers**: We should not forget the role of policy-makers, especially at the local level, who can make a huge difference by pledging their support to initiatives for saving energy, and by using their influence to promote BECA implementation to parties who are not yet fully convinced.

Stakeholders in one city might take on some of these roles while at other sites, others are responsible. For instance energy coaches can be employed either by the energy provider or by the housing company. In some cities, they are employed by the municipality.

The checklist below allows you to list all key stakeholders who need to be involved (including names of contact persons) and to document the main contribution you will require from each of them. An example would be customer data -- as will be discussed below, access to data (e.g. from meter measurement) often proves to be the bottleneck for implementation.

Checklist 5: Checklist for identification of stakeholders to be involved

Site:		**Building(s):**
Role	**Organisation/Contact names**	**Required contribution**
Customers = Tenants (also tenant association if existing)		
Housing Provider		
Energy Provider = Utility (a) Electricity, (b) Gas, (c) Heating [as applicable]		
Measurement Service Provider		
IT-Service Provider		
IT-Equipment Provider		
Provider of Energy Advice		
Social Insurance Carrier (i.e. party paying tenants' energy bills)		
Policy-makers		
Others:		

For each utility (e.g. electricity, gas, heating & warm water) you may need to cover one or a number of actors. Also note that providers can differ between units of your building portfolio – that buildings are being served by different energy providers, the list may need to be filled in separately for each building.

You will find another checklist in section 4.2.2 (page 54) for documenting incentives for participation from the viewpoint of each main stakeholder group.

4.2.2 Incentivise stakeholders

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

Involving all parties that have a stake in the “energy efficiency value chain“ in the implementation project is a key conditions for success. The presence or not of certain stakeholders within the “energy efficiency value chain“ plays a critical role in the availability and desirability of various options for implementation.

What is more, **all key stakeholders involved need to believe that the project is worth their effort**, i.e. their **financial resources**, but most importantly their **willingness to cooperate** and their **commitment to the project’s ultimate success**.

Experience has shown that various stakeholders may feel the need to resist or delay the introduction of energy-efficiency strategies based on smart metering technology. It is for this reason that **incentivisation** should be a core ingredient of any project for BECA implementation

This section discusses the main hurdles to achieving stakeholder buy-in, the role of diverging incentives, and ways how these can be tackled. The following section is structured according to the main groups of stakeholders to be involved, starting with what is unquestionably the most important one: customers, i.e. tenants.

Tenants/customers

“Before it is possible to attempt to provide behaviour changing education, communication or feedback to consumers, it is necessary to develop a basic understanding by customers of the most basic comprehension and appreciation of what it is that they are trying to change with their behaviour, and why. Customer knowledge of energy issues is in fact so low prior to energy efficiency or demand response programmes that the basic building blocks have to first be laid.”[18]

This quote, taken from VaasaETT’s study of a large number of pilots implementations of smart meter enabled energy efficiency and demand response programmes from around the world, clearly indicates the reason why you will need to prepare tenants so that they fully understand the benefits they have reason to expect from implementation of BECA services. The VaasaETT study concluded that “the main factor preventing the progress of Demand Response and indeed energy efficiency programmes is apparently the lack of appropriate and effective education, communication and feedback of information to consumers, in the face of negative consumer pre-dispositions towards energy utilities companies“[19].

The role of tenants in the implementation process is basically threefold. They:

- need to accept the installation of smart meters within their dwelling, i.e. collection and processing of much more detailed data about patterns of energy consumption by the members of a household;
- are expected to respond to the information presented to them in the chosen format (i.e. web platform, tablet platform, in-house-display, informative billing) in ways which reduce their overall energy use and/or reduce peak time energy use;
- in case of initiatives for load shedding, i.e. shift of energy-intensive activities from peak to off-peak hours, tenants also need to accept the loss of comfort (if there is any) involved as well as any restrictions to the freedom to choose e.g. times at which the dwelling is being heated.

This implies that consumers need to support the implementation at least passively if it is to achieve the desired energy efficiency improvements without endangering the quality of the relationship between tenants and housing provider.

In practice, however, **customers around Europe have sometimes turned against smart meters already before roll-out or after gaining some first experience with them**. This shows that no implementation project can take it for granted that tenants will easily realise the benefits of smart meter based energy efficiency and demand response services. Moreover, there may be active opposition if risks and downsides from consumers’ viewpoint are not properly addressed by the project.

While international experience shows that consumer acceptance of technological innovations is partly cultural, research suggests that the choices made by the utility and regulators are easily as important for consumer acceptance.

These are some recommendations for dealing with consumers which have proven effective in pilot implementations:[20]

- Installation of smart metering in homes should not feel mandatory. You should foresee some form of opt-out option for consumers, but make sure through appropriate promotional activities that opting out is perceived as foregoing a powerful means of saving money and contributing to the common good.
- You should have mechanisms in place to notice any signs of decent, worry or concern among tenants as soon as they arise, and to respond swiftly. Well informed employees who interact with tenants play a key role here. They should be able to answer standard as well as site-specific questions.
- The staff installing the meters should be adequately trained as well so that they can adequately answer consumers' questions and communicate the advantages of the technology rather than contribute to feelings of concern and uncertainty.
- A clear information package, designed for the purpose: Consumers need to have a basic understanding of how this new piece of technology works and why it is in their interest to have it installed in their home.
- Technical issues during roll-out, which even a very well prepared implementation might not be able to avoid, should be kept invisible to end users. In the case that a technical issue causes detriment to tenants, providers should make sure that they demonstrate goodwill.
- Management of consumer expectations is a key issue. The project owners should try their best not to make promises they cannot fulfil in a timely manner and without extra expense on the part of the consumer. While consumers must see some benefit from BECA roll-out directly, these expectations should not include promises of future programs but only explain benefits which will be available in a timely manner and (if not free) for a price clearly communicated beforehand to tenants.

There should be no doubt that transition to using energy efficiently can be difficult as it requires **widespread changes in habits**, ranging from turning off appliances when not in use to buying more energy efficient appliances. The balance between technical solutions for energy efficiency and human actions for energy efficiency needs to be weighed carefully, which explains why combination of EAS with EMS services is likely to be the most effective way forward.

Insufficient efficiency awareness among consumers can be one reason for lack of interest in the information provided by smart meters. Getting perceptions right is of essential importance. People may not have an accurate understanding of the effort needed to achieve energy efficiency and the resulting advantages in terms of energy consumption. In other words, they may feel too much effort would be required for too little return. Clearly, initiatives for raising awareness of potential savings, in monetary terms, are necessary to incentivise end users, i.e. tenants, of the benefits they can derive from BECA implementation. Housing providers should explore possibilities for using **Energy Coaches** for distributing personalised recommendations to their tenants.

In order to be able to design effective activities for awareness raising and promotion, you should have sufficient insight into your tenants' propensity to engage in energy saving behaviours, see box below. For this purpose, tenant surveys can be a useful approach, as can group discussions with tenants chaired by experienced moderators. In any case you will need to be careful to avoid perceptions that you seek to force tenants to adopt the innovation against their will.

How well do you know your tenants?

Market researchers have designed and tested ways to stratify customers in the residential housing sector according to their propensity to participate in energy saving measures. This research can be used to better estimate the potential share of your tenants who are likely to be willing – in principle – to engage in energy efficiency activities such as those discussed in the present guide.

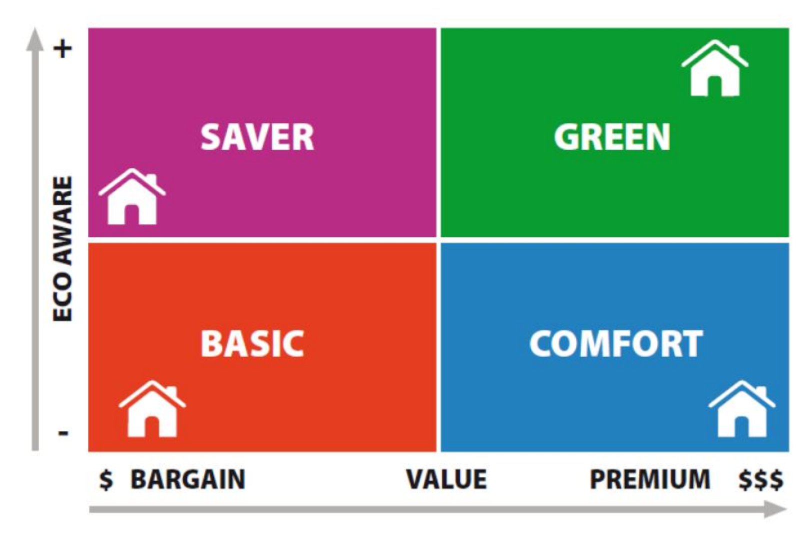
Depending on the data you have available about your tenants (which can also come in the form of personal knowledge of tenants), you should be able to assign each customer to one of the following four groups[21][22]:

1. **Basic**: Customers who want to save money, but who do not (yet) understand that they can do so by increasing energy efficiency. This group is little concerned with environmental issues.

2. **Comfort**: Those with large energy bills due to a preference for comfort (e.g. high room temperatures) combined with minimal interest in energy engagement, and limited concern about their bills.

3. **Saver**: Those who are primarily motivated by the opportunity to save money on their bills or mitigate potential bill increases.

4. **Green**: Those motivated by environmental concerns and willing to learn more about how they can get engaged.



Only those tenants in groups "saver" and "green" are likely to engage actively in energy saving measures. If these form a small minority only of all your tenants, implementation of EAS services are unlikely to achieve substantial savings – unless substantial efforts are undertaken to raise awareness about the cost saving potential of improved energy efficiency among those in the "basic" group of tenants.

If tenants have generally adopted a **negative attitude** to any initiative originating from the housing company, it will be all the harder to convince them of the benefits of BECA implementation. Housing providers, especially in the social housing sector where tenants do not have much freedom of choice where to live, need to be very clear about the fact that not all of their customers will be supportive of top-down initiatives for saving energy.

Consumer's pre-dispositions towards their energy provider are similarly fraught with problems. Energy providers' conduct towards end consumers is typically perceived as patronising: "Whether justified or not, a large proportion of utility consumers feel suspicious of utility companies when those companies promise to give the customer savings or benefits for free. Typically, though not always and not for all companies, consumers perceive that utility companies are more like tax collectors than charities. Their aim, in consumers' minds, is to provide a simple, monopolistic public commodity service and earn a good profit in doing so. The utility company makes money through the maximization of sales and price of that commodity. So when utility companies then claim to consumers that they want to save energy and that they intend to help the consumer to save energy and money, it is quite understandable that consumers often think that they can smell a rat.[23]

Under such circumstances, alternative channels for promotion of the project need to be identified and utilised. The initial message announcing the initiative to save energy and money should come from communication sources that consumers trust; a source that they feel is independent, ideally on their side and/or the side of the environment, but at least not on the side of the housing company or the utility. The municipality, consumer groups and local environmental organisations are possible candidates. Cooperation with community centres can be particularly effective for reaching ethnic minorities.

A key objective of such cooperation should be to "reassure tenants that guarantees and safeguards are in place to protect them from being duped, to protect them from higher costs, and to justify to consumers the logic and simplicity of their offering"[24].

Concerns about data security and privacy of data have been raised repeatedly in recent years in connection with the roll-out of smart metering. In the Netherlands, such concerns have already lead to a major backlash against a government plan, adopted in 2007, to equip all of the country's buildings with smart meters by 2013. In 2009 the Dutch government had to back down after consumer groups and privacy watchdog groups had campaigned vigorously against the plan. Instead of a mandatory roll-out, smart meters installation was made voluntary. The main causes of concern were as follows[25]:

- Hourly and 15-minutes readings give away information about the consumer's habits, such as when he or she leaves the house and when he or she returns. This information could be useful to burglars.
- Smart meters can provide insights into a family's living patterns and relationships "which can affect people's freedom to do as they please in the confines of their homes."
- There is a risk that information about a person's energy use will fall into the hands of third parties such as the police or insurance companies.

The debate in Netherlands should have made absolutely clear that projects for BECA implementation have to take the utmost care to take a rigorous and systematic approach to assessing and managing risks posed to data security and privacy. Recommendations have recently been published by the European Data Protection Supervisor (EDPS)[26], see box below.

Smart meters: consumer profiling will track much more than energy consumption if not properly safeguarded, says the European Data Protection Supervisor (EDPS)[27]

On Friday 8 June 2012, the (EDPS) adopted his opinion on the Commission Recommendation on preparations for the roll-out of smart metering systems, which gives guidance to Member States to prepare for the roll-out of these systems.

While the Europe-wide rollout of smart metering systems may bring significant benefits, it will also enable massive collection of personal data which can track what members of a household do within the privacy of their own homes, whether they are away on holiday or at work, if someone uses a specific medical device or a baby-monitor, how they like to spend their free time and so on. These patterns can be useful for analysing our energy use for energy conservation but together with data from other sources, the potential for extensive data mining is very significant. Patterns and profiles can be used for many other purposes, including marketing, advertising and price discrimination by third parties.

In light of these risks, the EDPS welcomes the efforts by the Commission to provide guidance to Member States. In particular, the EDPS supports the plan to prepare a template for a data protection impact assessment and submit it to the Article 29 Data Protection Working Party for advice.

At the same time, the EDPS regrets that the Commission has not provided more specific, more comprehensive and practical guidance in the Recommendation itself. However, he considers that some guidance can still be given in the data protection impact assessment template. In addition, further legislative action should also be considered.

Giovanni Buttarelli, Assistant EDPS, says: "the EDPS calls on the Commission to assess whether further legislative action is necessary at EU level to ensure adequate protection of personal data for the roll-out of smart metering systems an - in his Opinion - provides pragmatic recommendations for such legislative action. Some of these recommendations can already be implemented via an amendment to the Energy Efficiency Directive, which is currently before the Council and Parliament. These should at least include a mandatory requirement for controllers to conduct a data protection impact assessment and an obligation to notify personal data breaches."

The EDPS recommends, among other things:

• more guidance on the legal basis of the processing and the choices available to data subjects, including on frequency of meter readings;

• mandatory application of privacy-enhancing technologies ('PET's) and other ‘best available techniques’ for data minimisation;

• more guidance on retention periods;

• direct access to consumers to their energy usage data, as well as disclosure to them of their individual profiles and the logic of any algorithms used for data mining and information on remote on/off functionality.

Experience from other sector suggests that tenants are more likely to refuse to sign the approval for data collection if they have the perception that their private lives will be scrutinised or that the data collected will be used to their disadvantage. Note that what counts here are *perceptions* and not whether existing concerns are justified or not.

In general, consumers tend to consider a **trade-off** between, one the one hand, privacy and security concerns and, on the other hand, convenience and added utility – as experience with use of social networks on the Internet and mobile phones has amply demonstrated. This implies that you will have better chances to win over tenants if they are fully aware of the benefits they can derive from the BECA system, such as lower utility bills.

Housing providers

One of the main challenges facing attempts to implement EAS systems is related to what is called **split incentives**: The term describes the fact that decisions regarding investments in energy efficiency are often split between building owners (housing companies), who would be required to pay for smart metering systems, and building occupants (tenants), who would reap the rewards of lower running costs for energy. Total costs might be reduced by implementation of BECA, but because costs and benefits are split across different stakeholders it might still be rejected.

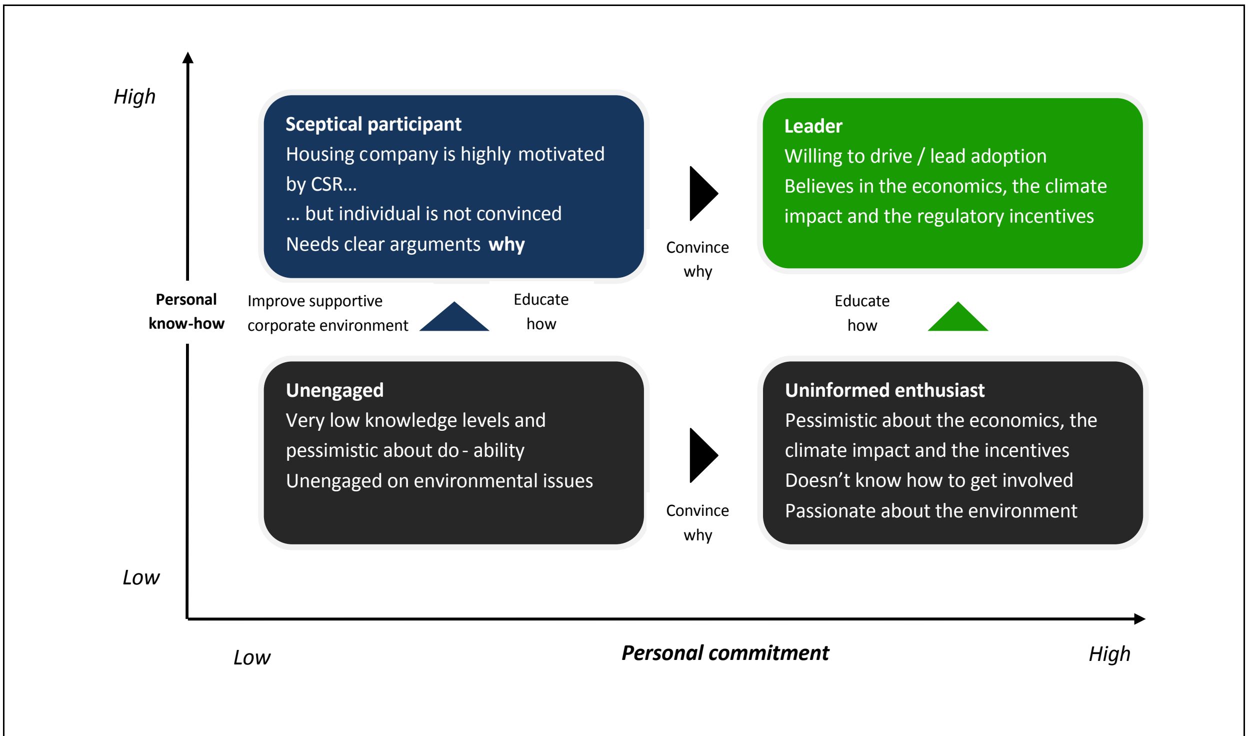
Moreover, calculation of future savings resulting from investments in energy efficiency includes several uncertainties, such as future energy prices and real estate market fluctuations. Housing companies who invest in higher energy efficiency cannot be sure of making a profit or even just recovering initial investments when re-selling the building.

There appears to be a general consensus, however, that energy prices are bound to increase over the medium to long term, irrespective of the occasional ups and downs in market rates.

Lack of capacity can also deter housing providers from investing in smart metering, as the expertise needed to assess available technical and organisational options is not readily available in many housing companies. For this reason, obtaining external expertise needs to be made as easy as possible, while some EU countries have large networks of energy advice agencies in a place that fulfil this role, in others availability of external expertise is still insufficient. In the latter case, lack of capacity, possible delays due to delivery time or extra fees paid to an expert can reduce interest in smart metering systems.

Housing company staff should not be assumed to favour implementation of energy efficiency measures. Experience shows that professionals tend to fall into one of four groups according to their practical knowledge of energy efficiency and personal commitment to the topic, see Exhibit 7. You can use this typology for classifying your staff to be involved in the implementation project.

Exhibit 7: Classification of professionals in the social housing sector[28]



Social housing buildings that are to be newly constructed or purchased present a special case. In the case of **housing stock to be newly constructed**, those involved tend to emphasise investment and construction costs without due consideration of buildings' future running costs. Often these involved parties only have a direct interest in the construction budget and not the total budget, and may be unwilling or unable to evaluate future costs, including those for energy and other resources. What is more, experience shows that few actors involved in a building's construction have the training required to analyse a building's lifecycle costs and guide construction practices to improve future efficiency. The known costs of construction are thus considered more carefully than unknown future costs. This focus on incremental costs can act as a barrier to energy efficiency investments in general, and also to investment in advanced smart metering based services.[29]

Owners or buyers of new buildings may mistakenly believe that the efficiency of a certain building is very good even if it is not. In particular, buyers may mistakenly believe that new constructions automatically are so much more efficient that there is no need to take any further action such as implementation of smart metering. Increased energy efficiency in new buildings will hence not be of concern even despite of feasible and compelling opportunities.

This might hamper have a negative impact on the willingness to invest in BECA services: When buyers feel satisfied with their putatively-efficient building, they are less likely to take further action to improve efficiency. [30]

Other challenges can derive from the regulatory environment, for example with regard to the issue of data security and protection of privacy. The difficulty here is that regulation of the field is still in development. As data protection gets paid more and more attention, **legal requirements for smart meter based systems** are bound to change over the coming years. For the time being, this situation will lead to uncertainties, for example with regard to investment decisions for smart meter technologies. In the BECA project, the pilot site in Karlsruhe installed meters in April 2011, but found out when new legislation was adopted in August 2011 (German Energy Act) that these meters did not comply with the new regulation's provisions. This leads to a significant delay in the project.

Given these challenges facing housing providers, it is clear that incentives need to be strong enough to make them commit themselves to BECA implementation. According to experience in BECA and other pilot projects, technical managers in housing companies are highly appreciative of the greater control over their buildings' functioning which smart meter based energy management systems offer them in their day-to-day work.

In the face of increasing pressure to make buildings more energy-efficient, EMS services empower technical managers to spot loopholes and weak points within the buildings' energy system and address them through carefully targeted interventions. EMS can also make energy distribution within buildings more efficient, resulting in cost savings e.g. in district heating systems and in systems including on-site power generation (e.g. renewables, CHP).

Energy providers / utilities

Utilities typically play an essential role in projects for implementation of smart metering because they tend to own the consumption data. They should always be included within the core team of a project for implementation of BECA systems.

If the utility is not included, experience shows that reaching agreement about supply of consumption data for the purpose of operating smart meters can be difficult; some energy providers / grid operators charge significant sums of money for giving access to the data, as was the case the Moulins BECA site.

Since adoption of the new EU's Energy Efficiency Directive in October 2012, energy providers know that they will be required to make their customers reduce their energy consumption by at least 1.5% per year. This means that utilities now have an intrinsic interest in initiatives to increase energy efficiency in the residential sector. While it will take some times before the Directive will have been translated into applicable national legislation, its adoption means that utilities are made aware that they need to contribute their share to Europe's policy on energy saving. There also appears to be a consensus among utilities that smart meters will have to play a key role if energy saving targets are to be met.

An additional incentive for energy providers is the concern among the utility industry "that some emerging solutions, and exciting ones at that, are being developed in ways that exclude the role of the utility. This is in part at least due to the commoditisation of energy efficiency solutions, but also apparently due to the slow speed at which the utilities industry is progressing with its commercial energy efficiency offerings"[31]. Active engagement in BECA implementation can be seen as one strategy for the utilities to have a say in the further development of the residential market for energy efficiency.

In general, incentives can differ between types of utilities. A distinction has to be made here between investor-owned utilities and municipal-owned utilities. The former are typically regulated by state public utilities/service commissions, while municipal-owned utilities have much more discretion in making decisions related to rate designing and energy efficiency, especially if the social housing stock in which BECA is to be implemented is owned by the municipality as well.

If utilities are owned by municipalities, local officials who intend to pursue energy-efficiency programmes can indeed benefit from distinct advantages.[32] However, not all cities owning utilities are committed to climate protection and energy efficiency, in which case utility ownership can possibly slow down a commitment to investments in energy efficiency due to the high costs that are often associated with such strategies[33]. On the other hand, owning a utility can present an opportunity for local governments to involve citizens in efforts to pursue "green" initiatives. For example, cities with municipal-owned utilities can directly engage in efforts to inform citizens of how much they can cut their utility bills through improving their energy efficiency, inform citizens of their green-house emissions, and sponsor strategies to reduce those emissions though various rebate programs.[34]

Measurement providers / IT service providers

The BECA project has shown that for successful roll-out of smart metering in the residential housing sector, not technology but access to consumption data was the most vital factor. One of the major challenges faced by pilot sites was convincing meter operators, who in most cases are also operating the electricity or gas grid, to grant access to meter data. Even more difficult it was to gain access to the meter infrastructure itself.

Circumventing existing meter devices can mean that separate metering devices must be installed for feeding data to demand response systems, which leads to inacceptable increases in costs for EAS or EMS implementation, and also presents a waste of resources.

Anecdotal evidence suggests that speeding up the replacement of smart meters for old meters can be bad economics from the viewpoint of measurement providers, as old meters are considered sunk costs but still generate significant return in the form of regular rental payments (ultimately paid for by tenants). For this reason, some countries have set up incentive schemes through which meter operators receive a premium for each old meter they replace by a smart meter.

Some Member States, including Germany, have adopted legislation that has liberated the metering market, to the effect that for instance housing providers can become meter operators themselves. As measurement providers have much more of the technical expertise required to operate meters, taking over meter management will however not be feasible for most pilot implementations.

One way to engage measurement providers can be to allow them to charge the full costs of the investment in smart meters to end users (tenants) by way of the social housing company. At the BECA site in Frankfurt this approach worked well as it forced the housing provider to convince tenants that their personal investment will yield them a return in the short to medium term.

Measurement providers might also be forced to cooperate as a consequence of national regulation (see section 4.1.2). This does not guarantee, however, that they will be fully motivated to make the project succeed. It is to be recommended, therefore, that measurement providers are included in the core project team to allow them to play an active and constructive role and to make suggestions based on their own interests as market players.

IT equipment provider

Providers of smart metering technology and related infrastructure expect huge growth rates in demand for their products, but they also realise that there are still major barriers to overcome before large scale roll-out will happen across all of Europe. For the latter reason, equipment providers have an incentive to support pilot projects as best as they can. Experience from BECA suggests that smart meter providers are willing and capable of supporting pilot projects with hands-on help and technical advice if needed.

Providers of energy advice

Many municipalities and also some social housing companies deploy staff that provide advice to citizens and tenants, respectively, in energy-saving matters. Such providers of energy advice have become more important recently as fuel poverty has become a topic of public debate and policy-making. If any provider of energy advice operates in the area of the buildings chosen to participate in BECA implementation, they should be actively engaged in the project.

The most useful approach appears to be cooperation with so-called energy coaches, i.e. individuals providing energy advice in one-to-one conversation. Research has provided strong evidence that energy coaches can play a vital role in projects seeking energy savings through changes of consumer behaviour[35]. An energy coach is a person who acts as tenants' guide throughout the implementation process, assisting consumers with understanding their energy consumption behaviour, finding ways how to save energy most effectively, and answering any related questions.

For their part, providers of energy advice should have strong motivation to participate actively in the implementation project, as BECA services can provide them with much improved information about current consumption patterns, on which basis more focused on personalised advice can be given to households.

Social Insurance Carrier

If energy bills are being paid for not by the tenants themselves but by the state, the social insurance carrier (e.g. the municipality) has an active interest in supporting any initiative that promises to contribute to energy-saving.

Local policy-makers / municipalities

Experience from the BECA project suggests that strong support from local or regional government for the implementation project can make it much easier to convince key stakeholders to show commitment. At the Catalonia BECA site, for example, the regional government's participation in the project was enough to make all other required stakeholders contribute actively. It is therefore recommended to seek support from local or regional governments at an early stage of the project's preparation phase.

Research has shown that the main factors expected to influence adoption of energy efficiency policy programmes in a city or region, are:

- Expectations of cost savings;
- Community wealth (as wealth is associated with the financial resources the municipality has available for spending on energy saving programmes);
- Economic development opportunities, including presence of business interests in the energy efficiency field;
- Co-benefits such as promotion of the municipality/region as a forerunner in climate action / energy saving;
- Demand voiced by citizens (= electorate);
- Climate risks (e.g. due to including coastal distance, hazard damage);
- The influence of neighbouring governments;
- State mandates.

Actual incentives as perceived by policy-makers and public sector staff in a city will most likely be a combination of some or all of these factors.

Concerning the cost saving factor, in state-owned social housing municipalities can only expect to save money via increased energy efficiency if they are the ones to foot the utility bill. This is often the case if tenants are dependent on transfer payments and the municipality responsible for home assistance. Municipalities can have non-monetary reasons for seeking to reduce the energy consumption of their own housing stock, however, e.g. in case the city has set itself a target for reduction of GHG emissions – as more and more cities in Europe do.

Municipalities can also benefit if they use the occasion of the project to foster communal involvement and citizen participation in activities which are for the common good, i.e. saving energy and reducing the city's carbon footprint (a goal which is on almost every European city's policy agenda today, at least formally). Research has established evidence that projects for smart grid implementation are more successful if they are embedded in communal strategies for climate action: Lewis et al.'s survey of best practice in smart meter enabled consumption feedback and demand response programmes[36] found that "a sense of communal involvement plays a major role in programme success [...]. Through public awareness campaigns, competitions and games, communities, neighbours and families can be brought together to help each other, inspire each other, and compete against each other. Good programmes also lead to extensive positive word of mouth communication."

Incentivisation: Summary

A good way to explore the different motivations among key participants in the implementation project is to ask each key stakeholder to fill out Checklist 1 (see page 33), and then to discuss the findings in a group discussion chaired by an independent moderator.

For documenting the results, you can use Checklist 6 below: List, for each stakeholder organisation, the incentives and disincentives that can be expected to influence their commitment to the project's goals, together with the actions you will need to take to create or strengthen incentives and get rid of disincentives.

If it is clear that a key stakeholder foreseen to participate in the project cannot be sufficiently motivated, you may need to seek alternative options. Otherwise, the project can be severely affected.

Checklist 6: Stakeholder incentivisation

Stakeholder organisation	Incentives / Disincentives	Action needed
Customers = Tenants (also tenant association if existing)		
Housing Provider		
Energy Provider = Utility		
Measurement Service Provider		
IT-Service Provider		
IT-Equipment Provider		
Provider of Energy Advice		
Social Insurance Carrier (i.e. party paying tenants' energy bills)		

Stakeholder organisation	Incentives / Disincentives	Action needed
Policy-makers		
Others:		

4.2.3 Build implementation team / identify champions

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

This step involves set-up of a team of qualified personnel to initiate and lead the implementation process. A **team of qualified and experienced personnel** from across stakeholder organisations to initiate and lead the project helps to ensure that the implementation plan (see section 4.3) is carefully crafted, with special emphasis to be placed on realistic work plan and adequate risk mitigation strategies. Bringing together a team of interested individuals with diverse backgrounds also serves to ensure that the implementation programme receives broad support from local stakeholders.

Assessment of incentives and motivations from the viewpoint of all main stakeholders will enable you to identify an **implementation champion** who can support the project by promoting it among her or his sphere of influence.

In this context it is worth pointing out that end users (tenants) who can act as multipliers should be involved as active participants of the implementation team as well, if feasible.

4.2.4 Reconfirm and adapt project goals

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

Once the implementation team has been set up and buy-in from the different stakeholder organisations has been obtained, the project goals as defined preliminarily in the first stage (see section 4.2.4) need to be reassessed, modified where needed, and then agreed upon by the implementation team.

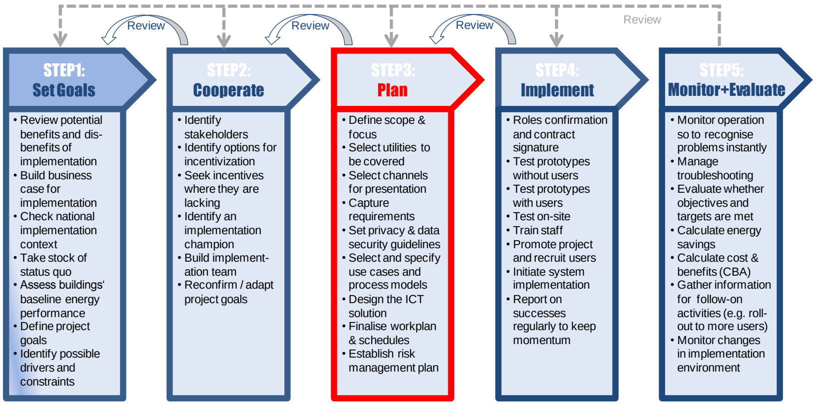
4.3 Plan: Designing the BECA implementation

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

This chapter outlines the main activities to be taken in the third stage of the project, which deals with the detailed work plan for BECA implementation and operation. This includes:

- Definition of the scope and focus of the service, i.e. what utilities should be covered by the service, what channels should be used for presentation of data to end users (tenants and provider staff), as well as operational objectives to be included in the work plan.



- Requirements capture, i.e. identification of the roles, user characteristics, and functional and service-related requirements the ICT solutions has to meet.
- Drafting of guidelines regarding how to protect data security and to ensure the desired degree of data privacy.
- Selection and specification of use cases and process models. A use case describes a sequence of actions that provide something of measurable value to an actor; an example would be providing tenants with the possibility to view and analyse their consumption data for any period they choose. Process models are descriptions of the way use cases are to be managed operationally by the provider.
- Design the ICT solution based on the requirements, use cases and process models.
- Finalisation of the work plan including schedule and a carefully designed risk management plan.

4.3.1 Defining scope and focus

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

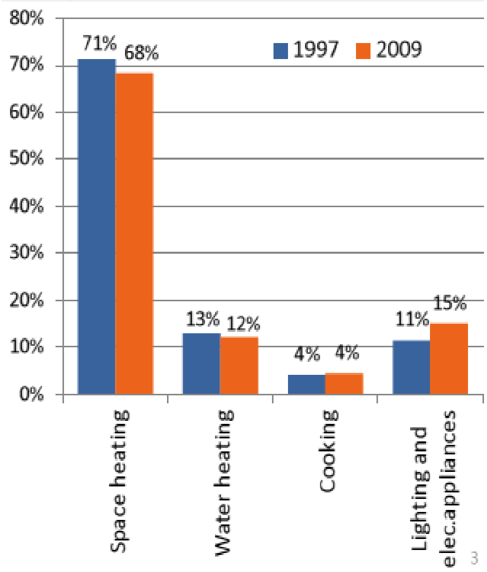
Selection of utilities to be covered by the service

Based on your project's overarching goals, as defined in the previous step, you will need to decide which utilities should be covered by the BECA service. BECA can target a wide array of utilities, namely electricity, heating and cooling (A/C), hot water, cold water, gas, or a selection thereof. The decisions which of these utilities to include in BECA service provision must of course be based on the national and local situation regarding implementation context and on your existing types of relationships with energy providers.

Some general recommendations, however, can be given.

If the objective is to achieve the highest possible energy savings with the smart services to be introduced, it needs to be kept in mind that three quarters of the energy used in the European residential buildings sector is for heating and cooling, a total of over 1860 PJ (roughly 517 TWh) per year. By comparison, only 12% are used for warm water, less than 2% for lighting, 8% for electrical appliances and 5% for cooking and other uses.

Given these patterns of energy consumption, it strikes as unfortunate that the discussion about potential uses of smart meter technologies tends to revolve around electricity. One explanation is that billing for (central or district) heating tends to be more complicated: while the consumed amount of electricity and gas can be measured directly, for heating an indirect measurement must be conducted, e.g. via heat cost allocators.



It is true, however, that energy use for electrical appliances has been increasing in the last decades (see figure to the right[37]), partly due to the larger number of ICT appliances in private households. Moreover, the share of electricity in average utility bills in the residential sector is much higher than its share of total energy consumption. Energy use for heating and cooling also strongly varies across Europe as a logical result of the different climates.

Still, heating is by far the largest consumer of energy in private residences and needs to be made more efficient if the required improvements in energy efficiency across Europe are to be achieved.

The decision on utilities to be covered should also take full account of the support you can expect to receive from the key players in the respective supply chain. As the discussion in the previous chapter has shown, access to metering data and infrastructure tends to be a precondition for successful introduction of BECA services. Choose only utilities for which this condition applies.

Considering peak demand and local storage

Existing buildings are storing energy. The materials used have a so called ‘latent storage’ capacity. Depending on the material used it can store large amount of heat (or cold) realising it faster or slower. Since heat (cold) energy can be converted into electricity (and vice versa), storage capacities of buildings can be used to store-up production capacities (e.g. CHCP) and supply of renewables (photovoltaic) for a given amount of time.[1]

BECA can intelligently balance local systems helping to mitigate similar problems and to ensure that local network connections are optimally loaded and transitory (stochastic) renewable output fully used. It is now recognised that local balancing by matching local supply and demand can not only reduce the number of hours of criticality locally, but as well help to balance load at a wider scale[2]. Opinion is also converging that VPPs are a key element in load balancing and an essential part of future smart grids[3].

“Ancillary services such as regulation and energy for balancing and ramping services from fast resources are required to meet the scenario of 33 percent renewables penetration. (Masiello et al., 2010).” The existing building stock is consuming 40% of all energy in the European Union. Some of the consumption is controllable. ICT can make use of this already existing store capacity ensuring that the existing infrastructure, such as local electricity grids – can tackle the challenge of ever growing shares of renewable production and, currently, often uncontrolled micro-generation.

1 Some times referred to as ‘Distribution Energy Storage Systems’ or DESS (IEA 2012) and Automated Demand Response or ADR (Lawrence Berkeley, 2012).

2 Hajek, B. (1990) ‘Performance of Global Load Balancing by Local Adjustment’, IEEF Transactions on Information Theory, 36(6): 1398-1414.

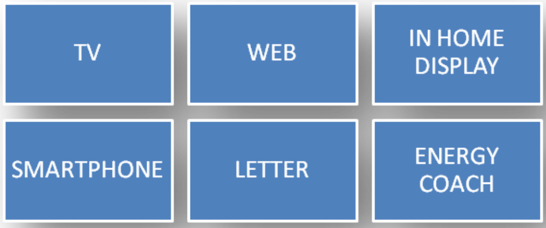
3 See e.g. VDE (2012) ‘Energy Horizon 2020’, www.vde.com

Selection of channel for representation of feedback

There has been a lot of debate in the field of smart meter enabled energy efficiency and demand response about which forms of feedback work best. Research conducted by the Empower Demand 1+2 projects[38], as well as experience from BECA piloting, has shown that **multiple feedback channels** tend to work best. It is certainly true that different consumers will prefer different channels and that no one-size-fits-all approach is likely to meet all needs and preferences.

The basic options, and their main advantages and limitations, for presentation channels are:

- **In home displays** were used in most early pilots, and can be an effective form of feedback if combined with appropriate activities for education and awareness raising. They tend to be more expensive and much less flexible compared to use of existing communication devices such as mobile phones and computers.



- **Applications for mobile devices** such as texting/SMS (for traditional mobile phones) or more advanced presentation in html (for Smartphones or tablets), are usually less extensive as tenants use their own end devices for reception. They can also be integrated more seamlessly with users' established behaviours, and benefit from the fact that mobile online services are considered more modern and attractive by some parts of the target audience, which can result in better response to the information delivered. Drawbacks include the well-known limitations of the SMS format (e.g. ASCII text) or, in case of html-based transmission, the need for consumers to be equipped with Smartphones or tablets – which cannot be taken for granted in the social housing sector.
- **Web portals** to be accessed through computers or smart mobile devices connected to the Internet offer the widest range of possibilities, e.g. in terms of personalisation of the presentation type and style, but need to be very well designed to avoid putting off users. A further advantage of html based presentation formats is that they allow hyperlinking to further information on separate pages or on the Web. This can make it much easier to supply users with recommendations tailored to their individual needs and preferences. Consumers should be able to download their consumption information to their computer or Smartphone. Drawbacks include the need not only for Internet access but also for the skills and motivation required to use the Internet effortlessly and frequently.
- Since not all residents of social housing buildings will have Internet access, the **television** can be a suitable alternative for data presentation. At the eSESH site in Moulins, a TV Energy Display System (see right hand figure) was implemented consisting of set-top boxes connected to residents' TVs via SCART or HDMI. When turn on their TV, the first thing tenants see is the Energy Consumption Channel comprising up-to-date energy consumption figures.

- In times when people easily

feel that they are being bombarded with information online, **paper-based letters** can still be a very useful alternative, especially if not (only) data but practical recommendations are to be communicated. The effectiveness of a letter-based approach depends, however, on the general relationship between tenants and provider (housing company or utility), see section 4.2.2: some tenants will perceive any letter from their utility and/or housing company as unwelcome. Letters will most likely be of value as complements to an interactive channel such as a web platform.

- **Other paper-based communication**, including leaflets with practical hints and recommendations, can also still play an important role – if done well and well aligned with other presentation channels.
- **Communication in-person** can be applied, of course, only in combination with some of the channels above. Use of **energy coaches** can be a highly effective means of providing information with the objective of changing tenants' energy consumption behaviour. Deployment of energy coaches is also recommended as a complement to feedback content which is complex and therefore not easy to understand and to translate into suitable behaviour. The more comprehensive and ambitious your project is, the more emphasis you should place on in-person communication.

Feedback channels piloted in the eSESH and BECA project are shown in the table below.

Exhibit 8: Feedback channels used in BECA and eSESH pilots

Site	Web	TV	Paper	Mobile app	In-home displays	Energy coach
BECA						
Belgrade	✓		✓*			
Darmstadt	✓					
Havirov	✓		✓			
Manresa	✓		✓*		✓	✓
Örebro	✓		✓*	✓		
Ruse	✓					
Torino	✓		✓*			
eSESH						
Angers	✓		✓			✓
Catalonia	✓		✓		✓	✓
Extremadura	✓		✓			
Frankfurt	✓			✓		
Karlsruhe	✓					✓
Linz	✓			✓		
Moulins	✓	✓			✓	✓
Solingen	✓					✓
North Italy	✓	✓	✓			
Westerlo	✓			✓		✓

*The same information could be sent by email if requested by the tenant

Experience clearly indicated that different feedback channels are appropriate for different purposes[39]:

- In terms of the content of feedback communication, there is a basic distinction between generic and personalised information, for which different presentation channels are most adequate. Individual recommendations are usually generic (unless provided in person e.g. by an Energy Coach), while the selection of recommendations to be given as well as analysis of consumption patterns need to be personalised.
- The need for personalisation must be carefully balanced against tenants' rights concerning data privacy, as discussed in section 4.3.3 below. If confidentiality of data is likely to be an issue, web-based platforms (especially if they look similar to online banking applications) appear more suitable than communication in person.
- In home displays provide feedback to all members of the household, while other end devices are typically used by one person only (e.g. Smartphone); the latter can be of disadvantage if all household members are targeted by measures for awareness raising and education.
- Communication via the phone provides the opportunity to deliver advice, support and warnings to customers at any time, regardless of where they are.
- Energy usage statements and smart bills can aggregate larger amounts of information to provide consumers with excellent explanations for their bills when they receive them, at the time they are most keen to receive such explanations.
- Online feedback via tablets, Smartphones or computers can provide a low cost alternative to in home displays for consumers wanting to know how much they are consuming and how much it is going to cost, while there is still time to do something about that cost before the next bill arrives.
- If time of use pricing schemes are applied, i.e. different tariffs for peak- and off-peak energy use, customers require an easily available reference guide to know e.g. when the next cheaper price period will start and end. Such information can be provided in the form of magnets to be stuck to fridges and washing machines.

Any feedback given to tenants needs to be **consistent with the bills** they later receive from the utilities, as the Empower Demand 2 report points out based on its comprehensive research into best practice[40]:

> *"Ultimately, the proof of the pudding is in the eating. Regardless of all the feedback that a customer receives, if the bill that comes to them at the end of a billing period is higher than previously or higher than they expected, or even not noticeably lower than previously, then a customer will be discouraged or in the worst cases [...] even highly critical of the feedback programme.*
>
> *A way to overcome this is to make billing as clear and informative as possible, […] which ultimately allows the customer to differentiate between increases in bills that are attributable to price increases as opposed to increases in consumption."*

Checklist 7 lets you check the feedback channels you have foreseen for your implementation against key requirements for feedback, as established in worldwide best practice. Each of the requirements should be met by at least one of your feedback channels.

Checklist 7: Check of presentation channels according to criteria

	Feedback channels selected			
↓ Requirements for feedback	e.g. Mobile	e.g. Website	e.g. Letters	Implications
Feedback should be personalised	yes no	yes no	yes no	*Write here...*

➜ Requirements for feedback	Feedback channels selected			
	e.g. Mobile	e.g. Website	e.g. Letters	Implications
	☐ ☐	☐ ☐	☐ ☐	
Feedback should be evolving, e.g. supporting and taking account of customers' learning process	yes no ☐ ☐	yes no ☐ ☐	yes no ☐ ☐	
Consumption data should be complemented by practical recommendations and advice	yes no ☐ ☐	yes no ☐ ☐	yes no ☐ ☐	
Need for personalisation should be balanced against customers' preferences on data privacy	yes no ☐ ☐	yes no ☐ ☐	yes no ☐ ☐	
All feedback data need to be fully consistent with billing data; if deviations cannot be avoided, suitable explanatory information needs to be provided	yes no ☐ ☐	yes no ☐ ☐	yes no ☐ ☐	
Feedback not based on kWh, but cost	yes no ☐ ☐	yes no ☐ ☐	yes no ☐ ☐	
Feedback available in real-time, but delivered by request	yes no ☐ ☐	yes no ☐ ☐	yes no ☐ ☐	
Content, quantity and style can be adapted by user to personal preferences	yes no ☐ ☐	yes no ☐ ☐	yes no ☐ ☐	
Feedback methods should be aligned with established behaviours (e.g. daily routines)	yes no ☐ ☐	yes no ☐ ☐	yes no ☐ ☐	
Customer can choose an alternative presentation channel if unable or unwilling to use the recommended one	yes no ☐ ☐	yes no ☐ ☐	yes no ☐ ☐	

4.3.2 Requirement capture

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

Before discussing the capturing of functional and service related requirements, on which basis the BECA technical solution will be designed, this section gives a short introduction to the methods for requirement capture.

Methods for requirements capture

Non-functional user requirements can be assessed in various ways. Experience shows that the following methods tend to be most effective:

- **Workshops** among professional staff – The first step should be a workshop between members of the implementation team plus professional staff who are responsible for day-to-day energy management in the building stock. The workshop should be used for preparation of subsequent involvement of members from the end-user target group (tenants in case of EAS).

- **Focus group meetings**: If you do not have much knowledge yet about tenants' perceptions and opinions about energy consumption and saving, a series of focus groups is recommended as the next step for requirements capture. In smaller building units, it might be possible to include all tenants in a series of focus groups. More likely, however, you will need to make a selection.
- **Questionnaire surveys**: If the target group is big or there is strong diversity between individuals, focus groups should be complemented by a questionnaire survey targeted at the entire tenant base, possibly in combination with an open discussion at a general tenants assembly. The survey instrument should be used carefully, however, since there are risks: In particular, surveys can raise expectations about upcoming improvements and activities, resulting in frustration if the organisation issuing the research (e.g. housing company) is not prepared to or not able to meet expectations later. Questionnaire surveys can also raise fears and doubts as to what the real intention behind the interviews could be. With no representative of the housing company around to answer questions and provide context, such uncertainty can quickly turn into scepticism and opposition to innovations.

For these reasons, focus groups are most recommended for requirement capture in the context of BECA implementation projects. The box below gives some hints about how to prepare and manage a focus group.

How to conduct a focus group meeting[41]

What are focus groups?

Focus groups are most often used as an input to design. A focus group involves encouraging an invited group of participants to share their thoughts, feelings, attitudes and ideas on certain subject, such as how to best save energy and cut utility bills. Organising focus groups within a social housing unit can also be very useful in getting buy-in to a project such as implementation of smart meter enabled energy efficiency and demand response services.

Advantages of focus groups

• Quick, cheap and relatively easy to assemble

• Good for getting rich data in participants' own words and developing deeper insights

• Participants are able to build on one another's responses, and they can act as checks and balances on one another

• Good for obtaining data from older people and people with low levels of literacy

• Provides an opportunity to involve people in the design process

Limitations of focus groups

• The responses of each participant are not independent

• A few dominant focus group members can skew the session

• A skilled and experienced moderator is required

• The data produced via a focus group needs to be carefully analysed

How to plan and prepare for focus groups

Invite around 5 to 10 people to participate for a session to last for about an hour. Then, prepare an agenda including a list of the top-level issues to be tackled (if appropriate).

Prepare an introduction script explaining the purpose of the day and how the day will be run. This can include issues of consent. Be sure to always use a quiet room with few distractions and arrange people in a circle (possibly around a table).

Running focus groups

If appropriate, ask the participants to introduce themselves and/or wear name tags. Most importantly, all questions you ask should be open and neutral. It's also important for the moderator to be aware of participants' energy and concentration levels and provide short breaks if necessary. The moderator should encourage free-flowing discussion around the relevant issue(s).

The moderator should also:

• Start on an issue people have strong feelings about and are familiar with

• Phrase issues in terms people will be familiar with

• Let participants know their contributions are valuable (both through what you say and also your body language)

• Step in and keep the session on-track if necessary

• Allow disagreements when they lead to new and interesting ideas, but manage them carefully

• Manage issues of power and privacy sensitively

Focus groups should end with the moderator winding-up the session by stressing all that has achieved and casting it in a positive light.

Managing risks

A number of potential problems could arise during focus groups, which will all need addressing:

• If one participant tries to dominate the session, the moderator should invite each person to speak in turn

• Avoid interviewing friends in the same group as they can form cliques

• Avoid personal confrontation – allow the group to police itself (e.g. "do others in the group agree?")

• Respect someone's right to be quiet, but do give them a chance to share their ideas 1-to-1 (e.g. during a break)

• Use differences of opinion as a topic of discussion – the moderator should avoid taking sides

How to encourage discussion

To facilitate useful, free-flowing discussion during the focus group, follow some of these tips:

• Ask participants to think about an issue for a few minutes and write down their responses

• Ask each participant to read, and elaborate on, one of their responses

• Note the responses on a flipchart/whiteboard

• Once everyone has given a response, participants will be asked for a second or third response, until all of their answers have been noted

• These responses can then be discussed

How to report

The minutes, or a summary document, should be produced for each session. A report should be written up, containing relevant profile information about the people who attended the session.

Care needs to be taken that activities for requirement capture are fully aligned with the schedule and approach taken for promotional activities and user recruitment, see section 5.4 below.

Roles

The technical service design for BECA services (both EAS and EMS) distinguishes between the following roles: Utility/Measurement Service Provider; Housing Provider; Tenant.

Accordingly the systems being associated with these different roles can be subdivided into three different layers:

Utility/Measurement Service Provider

Central IT-Infrastructure and Services: IT components (software and hardware) are needed to manage all the different meters (electricity, gas, water, heating), the communication equipment and the measured data.

Communication Equipment: This layer subsumes all the components, protocols, etc., which are needed to realize the communication between meters and the central IT infrastructure (Servers etc.)

Metering Infrastructure: All the meters (electricity, gas, water, heating etc.) are summarised in this layer. Communication units (modems etc.) are NOT allocated to this layer – these components belong to the layer “Communication Equipment”.

Housing Provider

Central IT-Infrastructure and Services: IT components (software and hardware) are needed to manage all the different meters (electricity, gas, water, heating), the communication equipment and the measured data.

Communication Equipment: This layer subsumes all the components, protocols, etc., which are needed to realize the communication between meters and the central IT infrastructure (Servers etc.)

Metering Infrastructure: All the meters (electricity, gas, water, heating etc.) are summarised at this layer. Communication units (modems etc.) are NOT allocated to this layer – these components belong to the layer “Communication Equipment”.

Tenant

Web-Portal, Mobile Application: By providing the Web-Portal and/or a mobile application the tenant will have access to his consumption data or other information provided. Additionally it might be possible to enter some tenant specific parameters (temperature etc.) as it might be necessary in energy management systems.

Communication Equipment: This layer subsumes all the components, protocols, etc., which are needed to realise the communication between meters and the central IT infrastructure (servers etc.)

Home Appliances: This refers to all those components that are installed at the customer's site to capture readings of sensors and to control actuators. Typical representatives of these systems are classical Home Automation Systems.

In spite of the variability of the implementation contexts across Europe, a large degree of agreement has been found regarding the main user characteristics and requirements following from these.

User characteristics

A key determinant of user requirements are the **main characteristics of social housing tenants**. Research using large-scale surveys of social housing tenants across Europe established evidence for these features:

- A large share of social housing tenants are above 60 years of age – typically around 40%;
- By definition, social housing tenants have levels of income that are significantly below the national average, and many live on social security benefits;
- Available data suggest that even today, more than one in two social housing tenants in the EU has no home access to a computer and the Internet. Those who have access tend to have low levels of digital literacy;
- A significant share of social housing tenants are from ethnic minorities and has limited capability to use the national language of their resident country;
- Directly associated with the four factors above, educational attainment levels are below national average.

These characteristics need to be taken into account fully when designing services which require active participation of tenants in the social housing sector. Exhibit 9 summarises some of the key requirements following from the user characteristics found in BECA pilot sites.

Exhibit 9: BECA requirements following from key user characteristics

Characteristic of user group	Requirements
Large group of older people	• System/service design and dialogues should be compatible with user expectations (e.g. consistent dialogues) • Users should be able to determine pace and sequence of the interaction with the system/service • Similar functions should act the same throughout the system/service • Avoid memory overload through avoiding multiple steps to perform an action • Minimise workload through well organised desktop / displays • High contrast between characters and background • Alerts and warning messages: flash rather than have it come on and stay on • Avoid extraneous design: display only relevant graphics • Use familiar icons and symbols, e.g. traffic lights; avoid long text messages • Positioning of labels, icons, text messages should be consistent • Avoid jargon or unfamiliar terms; use non-technical language • Text on buttons should be descriptive (“send message” instead of “send”) • Use colours thoroughly and bear in mind colour blind people. A status should (hot =

Characteristic of user group	Requirements
	red, cold = blue) but also with associated text.
Large group of low income earners	• Need for directing motivational measures towards increasing service usage (e.g. monetary presentation of consumption in € to show saving potential at user level) • Need for awareness raising about wider benefits of energy saving
Low home-based internet access rate	• Alternative service access channels enabling to cater for given local peculiarities/circumstances • Options include set-up of public terminals for Internet access at entrance of buildings, access via TV, mobile phone applications, paper based information together with housing company brochure/newsletter • Capacity building specifically tailored towards novice users (e.g. low-threshold training measures where subsidised/donated access channels are provided)
Migrants highly represented	• Provide clearly visible language button (country flag) at the start of the service use • Need for service/interface design that allows to cater for language/cultural diversity • Need for capacity building specifically tailored towards users with restricted language capacities • Use of Plain Language (see below)
Low education levels over represented	• Use of Plain Language, i.e. language that emphasizes clarity, brevity, and avoidance of technical terms. • All use of language should be in a way that is easily understood by the target audience: clear and straightforward, appropriate to their reading skills and knowledge, free of wordiness, cliché and needless jargon.

It is important to mention that most providers of smart metering technologies tend to focus on upper segments of the residential market, i.e. high-income households, which have very different capabilities and preferences compared to social housing tenants. This means that projects for BECA implementation in the social housing sector need to take special care that the components chosen are fully adequate for meeting all requirements. For example, the large share of social housing residents who are 65 years and older means that presentation formats must be sufficiently accessible for persons with functional restrictions and disabilities.

Functional requirements

Research in BECA and other studies undertaken in the area have identified a number of requirements according to the different user groups of both EAS and EMS. Functional requirements for BECA are presented under the following headings:

- Service features/visualisation requirements
- Frequency of consumption data visualisation requirements
- Media of presentation requirements for BECA pilot sites
- Privacy and data protection requirements

Service features/visualisation requirements

Experience from best practice has shown that service features for successful feedback are[42]:

- based on actual consumption (i.e. accurate and trustworthy);
- frequent (ideally daily or more often);
- involve interaction and choice for households;

- involve appliance-specific breakdown (the review relates to electricity);
- given over a prolonged period;
- may involve historical or normative comparisons (although the effects of the latter are less clear) presented in an understandable and appealing way.

Historical comparison as mandated in EU Directive 2006/32/EC, e.g. comparing electricity use now with the same period of time the previous day has become the preferred approach. To be useful, users must understand how any differences relate to changes in energy use behaviour in the two time periods which are compared.

Users typically require separate visualisation for different energy sources and consumptions, i.e. for each energy type individual presentations should be developed and presented, one for each: electricity, gas, heating, hot water, cold water, etc. In terms of consumption unit the demand appears to be for KWh or /m³ but also for actual costs CO_2 emissions as measurement unit for presentation, has not appeared so far among end user requirements, at least in the social housing sector.

The key benchmark for comparing a tenant’s energy consumption has been found to be historical consumption data from previous periods (days – weeks – months – years) and square meter (m²). All other benchmarks appear to be of significantly less importance.

Interest in receiving personalised energy saving recommendations tends to be strong wherever it has been offered. The same applies to generation of regular, personalised reports (each day/week/month/year) on energy consumption, whereby most seem to be satisfied with these reports being provided for download in the portal. BECA research found that only very few pilot participants had an interest for SMS-based reporting.

Demand for other advanced features has been found to vary strongly between pilot sites where research took place. This applies to features such as target setting, i.e. possibility to define targets for hourly/weekly/monthly consumption of specific energy types; options for ‘forecasting’ data of consumption to see whether advance payments or ‘targets’ will be reached; and alerts, i.e. the automatic generation of alerts created if irregularities occur (pre-defined by user) and shown when the user logs into the portal.

Multi language support where the user is able to choose his/her preferred language tends to be required at locations with large numbers of tenants with migration background.

Frequency of consumption data visualisation requirements for BECA pilot sites

The requirements analysis revealed that the potential users of the BECA services are well aware of the most appropriate frequencies of energy consumption data visualisation needed to best judge on and find starting points for changing behaviour. Electricity consumption behaviour analysis and assessment requires short time intervals of electrical equipment use to more easily identify times and sources of large consumption. Monthly data would hardly help in identifying these. Therefore there is the clear requirement for 15 minutes measurement intervals followed by daily and hourly intervals to support them in identifying options when and where to adjust their own behaviour with the aim to achieve savings in electricity consumption and costs.

However, with respect to heating the requirement is for rather frequent measurements, hourly followed by daily and monthly.

To allow the tenant to directly see the amount of detail he desires it is necessary to ask for the frequency in which consumption data should be displayed. The options are usually: Every 15 minutes (for electricity) – Hourly – Daily – Weekly – Monthly – Quarterly – Semi-annually.

Does the tenant request reporting only on paper (see below), the information presented for the various benchmarks, detail is limited by the number of pages to be printed.

Media of presentation requirements
A web-based service is as a core requirement. Still, one has to bear in mind those tenants without Internet access who need to be served by other media like paper-based reports which was also high in demand by a majority of the pilot sites. In the social housing sector, this requirement will continue to be relevant in the coming years.

Use of in-home displays presents an alternative to the requirement for users to have Internet access. In BECA, very good experience has been made with these in Catalonia.

First positive experience has been made with mobile applications (apps to run the service on smart phones). It is to be expected that this channel will become a major means of delivering EAS services in the future, partly due to the popularity of Smartphone based computing.

Use of energy coaches for educating and communicating with tenants has been found to bring significant benefits when integrated smartly with online and other offline interaction channels. Within eSESH, this model has been piloted in the French pilot sites, Catalonia, Karlsruhe, Solingen and North Italy to increase the use of the service and thereby achieve additional savings in energy consumption.

Privacy and data protection requirements
Privacy and data protection issues are highly relevant for BECA service implementation, e.g. in relation to the individual access to the service, consent to be given prior to data use including the possibility of a withdrawal of consent, tenant knowledge about the person in charge of data controlling and data processing and need to only present data of other individuals (for benchmarking/comparison purposes) in an aggregated and anonymised format. For further details see section 4.3.3.

The box below provides a summary of service and user requirements. A checklist is available in the annex (see section 9.7 on page 156).

The most important technical requirements for BECA & eSESH service development

• Separate visualisation for different energy sources and consumptions: electricity, gas, heating, hot water, cold water, etc.;

• Units of consumption: kWh/m³ / € / CO_2;

• Benchmarks:

  o historical data from previous periods (days – weeks – months – years)

  o other/average tenants

  o similar dwelling

  o per m²

• Target setting: define objective for hourly/weekly/monthly consumption;

• ‘Forecasting’ data of consumption to see whether advance payments or ‘targets’ will be reached;

• Alerts: automatic alerts are created if irregularities occur (pre-defined by user): alerts are shown if the user logs into the portal, or sent by email, or texting (SMS);

• Regular reports are created each month and are shown in the in portal or sent by email, SMS or as a letter;

• Saving tips: the user receives personalised tips how to save energy and/or water;

• Self assessment tool: the user is able to assess her/his own behaviour;

• Frequency of consumption data visualisation requirements

  o Hot water: highest frequency consumption data is visualised in: hourly o Cold water: highest frequency consumption data is visualised in: hourly

• Media of presentation requirements for eSESH / BECA pilot sites

o Web

o TV

o Mobile app (for Smartphones or tablet computers)

o Paper

o Energy coach

• Individual access with username and password: Access to the service by registration introducing username and password (in compliance with regional/national/European data protection legislation);

• Withdrawal of consent: the user has the possibility to withdraw his/her consent and data;

• Anonymised user data: Each individual user has only access to his/her own data - if benchmark possibilities are given he/she can access anonymised data for other tenants/dwellings/buildings.

4.3.3 Guidelines for privacy and data protection

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

Protection of data security and privacy in projects for implementation of smart meter enabled services should not be added on as afterthoughts, but they need to be an integral part of the project design phase, as BEUC, the European Association for the Co-ordination of Consumer Representation in Standardisation (ANEC) has stressed: “Privacy should be designed into smart meter systems right from the start as part of the compliance life-cycle and include easy to use privacy-enhancing technologies. We urge to make the principle of privacy by design mandatory, including principles of data minimization and data deleting”[43].

Personal data to be collected, processed, diffused and/or stored within the context of BECA service provision are:

- Tenant identification;
- Address;
- Real-time data on water and energy consumption;
- Historical (time-series) data on water and energy consumption;
- Real-time data from sensors installed in the flat (temperature)
- Historical (time-series) data from sensors installed in the flat (temperature)

The main European regulation of relevance is **Directive 95/46/CE** which deals with collection, processing, diffusion and storage of personal data. Some of the main concepts used in the Directive are listed in the box below.

Main concepts used in EU Directive 95/46/CE on the protection of individuals with regard to the processing of personal data and on the free movement of such data

Personal data means any information relating to an identified or identifiable natural person ('data subject'); an identifiable person is one who can be identified, directly or indirectly, in particular by reference to an identification number or to one or more factors specific to his physical, physiological, mental, economic, cultural or social identity.

Processing of personal data ('processing') means any operation or set of operations which is performed upon personal data, whether or not by automatic means, such as collection, recording, organization, storage, adaptation or alteration, retrieval, consultation, use, disclosure by transmission, dissemination or otherwise making available, alignment or combination, blocking, erasure or destruction.

Personal data filing system ('filing system') is any structured set of personal data which are accessible according to specific criteria, whether centralized, decentralized or dispersed on a functional or geographical basis.

Controller means the natural or legal person, public authority, agency or any other body which alone or jointly with others determines the purposes and means of the processing of personal data; where the purposes and means of processing are determined by national or Community laws or regulations, the controller or the specific criteria for his nomination may be designated by national or Community law

Processor is a natural or legal person, public authority, agency or any other body which processes personal data on behalf of the controller

Third party means any natural or legal person, public authority, agency or any other body other than the data subject, the controller, the processor and the persons who, under the direct authority of the controller or the processor, are authorized to process the data.

Recipient means a natural or legal person, public authority, agency or any other body to whom data are disclosed, whether a third party or not; however, authorities which may receive data in the framework of a particular inquiry shall not be regarded as recipients;

The data subject's consent means any freely given specific and informed indication of her wishes by which the data subject signifies her agreement to personal data relating to her being processed.

The Data Protection Directive has a direct impact on the implementation of the project’s EAS and EMS solutions. BECA services are focused on improving tenants’ resource management service involving personal data of their consumption behaviour. However, the information collated is not always subjected as personal data and it depends on the exact services to be deployed what type of information will be collected and processed.

The collection, processing and transmission of personal data must be analysed under the principles of Directive 95/46/CE and especially of the national laws taken for its application. Any additional regulations at national level that are not in the Directive and apply to data protection or any other sensitive information also need to be taken fully into account for project development.

You can use the checklist on the next page for documenting the type of personal data which needs to be collected for enabling system operation.

Checklist 8: Use of personal data

Service		Data Subject	Are personal data involved?	Type of data processed													
				Identity data		Consumption data					Comfort and climatic data			System functioning data			
Name of the service	Type (EAS or EMS)	Building, dwelling, household, tenant, others	Yes / No	Name of natural person	Address	Cold water	Hot water	Heating	Electricity	Natural gas	Room temperature	Room humidity	Outdoor temperature	Thermal system performance	RES performance	Room thermostat set-point	Heating circuit temperatures (flow and return)

Regarding the Directive's principles, honesty and transparency refer to inform the data subject that their personal data are being used. Therefore, data managed during BECA implementation should be processed only under the following preconditions (Art. 7, Directive 95/46/EC):

- When the data subject has given her/his consent;
- When the processing is necessary for the performance of or the entering into a contract;
- When processing is necessary for compliance with a legal obligation;
- When processing is necessary in order to protect the vital interests of the data subject.

The rights of the tenants from whom information has been collected are the:

- Right of access to collected information;
- Right of correction of this information;
- Right of opposition to the collection and the processing, in particular right of opposition to the processing at ends of commercial campaigns or use by third parties and to the transfer.

The main service related requirements which result from EU regulation on collection, processing, diffusion and storage of personal data are the following:

- Individual access with username and password: Access to the service by registration introducing username and password (in compliance with regional/national/European data protection legislation);
- Consent for use of own data: before the first log-in and to use the service the user needs to give his/her consent that his/her data can be processed by the service provider;
- Withdrawal of consent: the user has the possibility to withdraw his/her consent and data;
- Clearly identifiable data controller and data processor: the user has access to information about who is the data controller and data processor of the service;
- Anonymised user data: each individual user has only access to his/her own data - if benchmark possibilities are given he/she can access anonymised data for other tenants/dwellings/buildings.

In practice, meeting all data protection regulations can raise challenges because regulation in the area is undergoing continuous change, partly in response to newly emerging risks introduced by new applications of ICT using personal data. In the Europe Union, a major update of data protection regulation framework is imminent, and it is not clear yet to what extent this will impact on provision of EAS and EMS services. Implementation projects need to make sure that any new developments will be properly reflected in their planning as soon as possible.

Projects expecting opposition to smart meter implementation because of data protection related reasons should consider engaging an **independent data privacy officer** who advises the implementation team and responds to questions raised by tenants in all issues relating to the topic, and across all stages of the project.

Additional measures should include additional **training** of the professional staff involved from the housing company in data protection. If not in place so far, the housing company needs to develop sufficient sensitivity to the privacy topic in order to prevent individual employees from misconduct, which can quickly lead to a major backlash against smart meter implementation.

Use Checklist 9 for making sure that you have all major issues concerning data protection covered in your project's work plan.

Checklist 9: Data security and privacy[44]

Checklist data security and privacy	done	to do
Check national legislation and industry self-regulation concerning data protection in smart meter based service provision	☐	☐
Seek advice from independent data protection experts	☐	☐
Draft data protection policy	☐	☐
make sure the data protection policy covers all elements and steps of the implementation process	☐	☐
Assign independent data privacy officer	☐	☐
Inform tenants pro-actively about the main data protection issues and how these are addressed by the project	☐	☐
Train own professional staff in data security and privacy	☐	☐
Check whether third parties must be given access to tenant personal data as well	☐	☐
Obtain data subject's consent (letter of consent from all tenants)	☐	☐

4.3.4 Designing Use Cases and Process Models

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

Based on the service and user requirements discussed in the previous chapter, use cases and process models can be designed.

A use case is simply a structured textual description of specific use of a service, focussing in particular on activities by users (customers/tenants, categories of staff, other users) and outputs to each user not only of the ICT system but of any part of the socio-technical system. Each use case is documented in a number of sections:

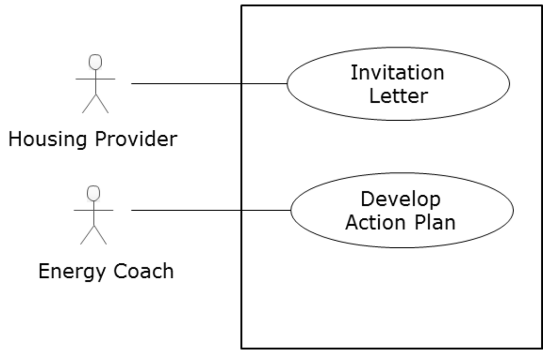
- **Roles**: A description of persons active in the use case – name and relevant characteristics.
- **Clients**: description of end-users (receivers of service) involved in the use case – names and characteristics relevant to the use case.
- **Socio-technical system (STS)**: Description of the ICT components and applications and use / staff roles in the system.
- **Use case body**: a) description of the outset / problem situation b) STS response focussing on outcomes of the response visible to each user type (end-user, professional etc.) c) autonomous events changing the situation d) STS response (etc.)
- **Technical application system (TAS)**: A detailed description of the functional requirements the use case presents to the ICT applications which are to support it.
- **Service integration**: Features of the use case illustrating integration with other services / application usage.
- **Possible variants and improvements**: Options use case authors have discussed in terms of the content and the TAS requirements both as alternatives and as improvements to the case described.

- **Assessment**: Advantages and disadvantages in comparison to alternative systems/services, a concise summary of the relative improvements presented by the services in the use case, not hiding possible disadvantages such as greater costs.

Use cases are used to illustrate key benefits provided by the service including where appropriate how service delivery is adapted to special requirements of users. For any but the simplest of services, two or three use cases will be needed to properly illustrate all key service responses which must be present in the final implementation. In cases of fully automated services, the description of the sociotechnical system is empty and the set of roles includes the end-user only.

Documentation of use cases according to UML notation standards is recommended, see table below.

Exhibit 10: Use case description format (UML notation)

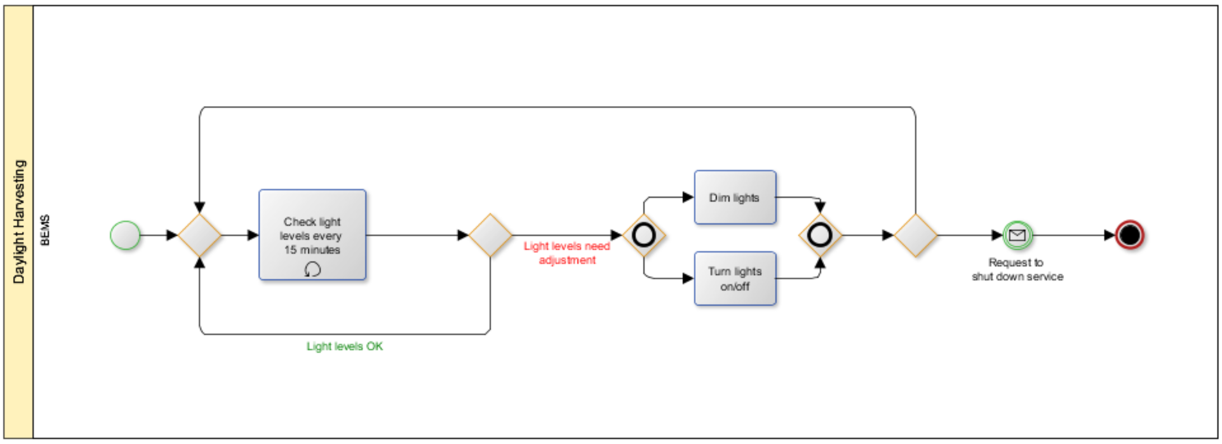
	Actors may represent roles played by human users, external hardware, or other subjects. Note that an actor does not necessarily represent a specific physical entity but merely a particular facet (i.e., "role") of some entity that is relevant to the specification of its associated use cases. Thus, a single physical instance may play the role of several different actors and, conversely, a given actor may be played by multiple different instances.
	The main purpose of a use case diagram is to show what system functions are performed for which actor. Roles of the actors in the system can be depicted.

The **process of designing use cases** is as follows:

- Identify all the different users of the system.
- Create a user profile for each category of user, including all the roles the users play that are relevant to the system.
- For each role, identify all the significant goals the users have that the system will support. A statement of the system's value proposition is useful in identifying significant goals.
- Create a use case for each goal, following the use case template. Maintain the same level of abstraction throughout the use case. Steps in higher-level use cases may be treated as goals for lower level (i.e., more detailed), sub-use cases.
- Structure the use cases. Avoid over-structuring, as this can make the use cases harder to follow.

While use cases try to catch the basic scenario which shall resemble the implementations across a range of pilot sites at each step, **Process Models** depict all implemented paths to resolve the base flow and, in some instances, more detail particular to one site of implementation. An example of a process model is depicted to the right.

Exhibit 11: Process model example

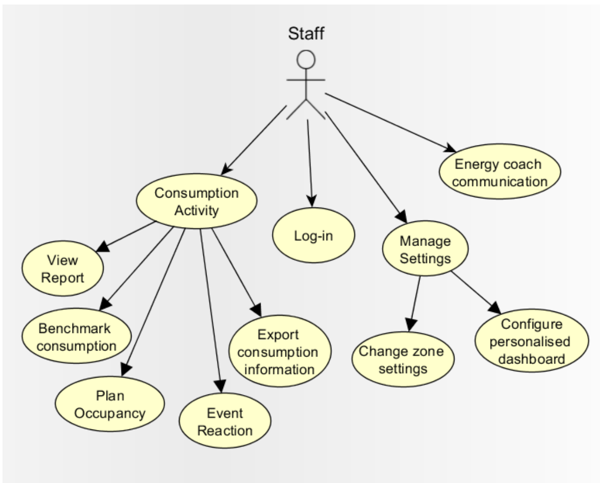


The **process of designing process models** is as follows:

- For each use case, create a first outline of the process model set based on the developed use cases. Model as much details as possible.
- Refine the process model set based on feedback from the implementation site so that it is understandable and ready to be utilised by all business users. If needed, generalise or further specify models so that they fit all site service processes.
- Create a final set of process models. Validate their technical accuracy against the BPMN specification.

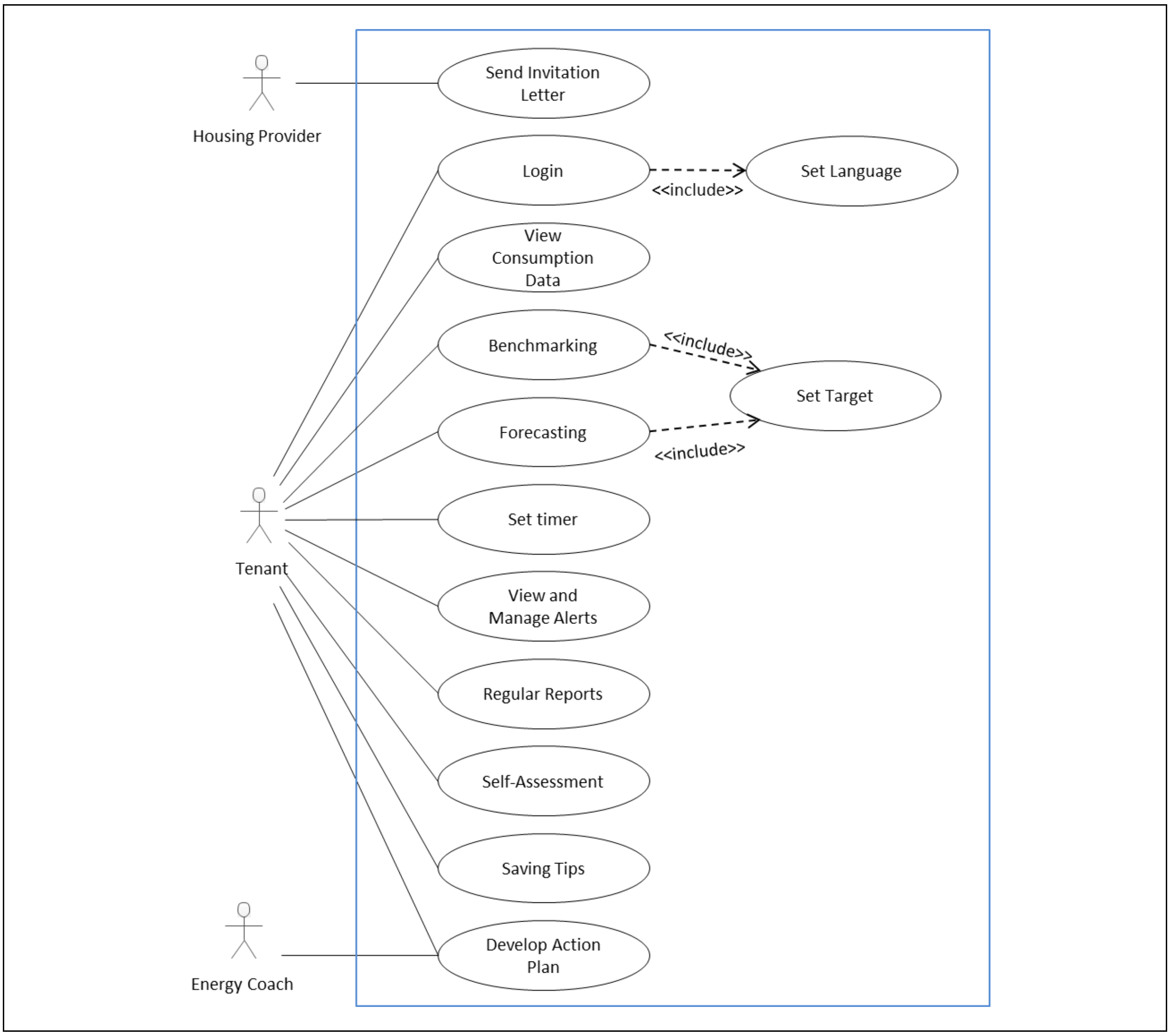
Both use cases and process models then need to be reviewed and validated with users (for methods for involving users in the system design, see section 4.3.2). At this stage, you will also need to iterate the entire chain of events a second time, and cross examine whether updates to process models affect use cases and vice-versa.

The use cases developed for each user type are then collected in a **goal list**. The goal list summarises all use cases that are to be presented and illustrates how they depend on each other, i.e., the top level view of use case shows all user use cases. Furthermore, the goal list works like a map allowing the reader to trace back activities and to identify quickly which other linked or related use cases the user will have access to given his location on the map. An example of a goal listed is presented in the figure besides.



The BECA project has produced use case for the following 13 activities, which are expected to be of most relevance for other projects on implementation of smart meter based energy efficiency and demand response services as well. These are depicted in the figure below and described in the annex (see chapter 7).

Exhibit 12: Use cases for BECA Energy Awareness System



From these 13 use cases, BECA pilot sites selected those which they needed to support based on the functional and service-related requirements captured at their site, i.e. for their social housing building or portfolio, see Exhibit 13.

Exhibit 13: Use cases selected for each of the 7 BECA pilot sites

BECA Use Cases	Pilot site with use case implemented						
	Örebro	Manresa	Darmstadt	Torino	Havirov	Ruse	Belgrade
UC1: Login	X	X	X	X	X	X	X
UC2: Set Language	X	X		X			
UC3: Send invitation letter		X		X			
UC4: Forecasting	X			X		X	
UC5: View Consumption Data	X	X	X		X	X	X
UC6: Benchmarking	X	X	X		X	X	X

BECA Use Cases	Pilot site with use case implemented						
	Örebro	Manresa	Darmstadt	Torino	Havirov	Ruse	Belgrade
UC7: Set target	X	X				X	
UC8: Saving Tips	X	X		X	X	X	X
UC9: Alerts	X	X		X		X	X
UC10: Reports	X	X			X	X	X
UC11: Self-assessment	X	X	X	X		X	
UC101: Monitoring and visualisation	X	X	X	X	X	X	X
UC102: Heat curve correction	X		X	X			
UC103: Maintenance warning		X	X	X			
UC104: Setting alerts		X			X		X
UC105: Sending messages to user		X					

Exhibit 14: Use cases selected for each of the 10 eSESH pilot sites

eSESH Use Cases	Pilot site with use case implemented									
	Angers	Catalonia	Extremadura	Frankfurt	Karlsruhe	Linz	Moulins	Solingen	North Italy	Westerlo
UC1: Send invitation letter	X	X	X	X	X	X		X	X	X
UC2: Login	X	X	X	X	X	X		X	X	X
UC3: Set Language		X		X						
UC4: View Consumption Data	X	X	X	X	X	X	X	X	X	X
UC5: Benchmarking	X	X	X	X	X	X		X	X	X
UC6: Set target	X	X								
UC7: Forecasting	X			X			X	X		X
UC8: Set timer					X	X		X		
UC9: View and Manage Alerts	X	X		X	X		X			
UC10: Regular Reports	X	X	X	X				X	X	
UC11: Self-assessment	X			X						
UC12:Saving Tips	X	X	X	X	X	X	X	X		X
UC13: Develop Action Plan (role: Energy Coach)	X				X		X	X		

The use cases and process models developed in the BECA project are universally applicable to all BECA pilot sites whereby not always all of them apply to each pilot site. They have been designed in a way to ensure widest possible applicability also outside the social housing context and can be taken and used directly by other actors interested in service replication

4.3.5 Design the ICT solution: Systems architecture, specification and system components

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

Considering the wide range of services (EAS / EMS) to implement, even within a single pilot, the diversity of technologies used, the multitude of parameters to control, and the large amount of data to manage, and safety requirements, BECA opted for Service-oriented Architecture (SOA), as the concept of software architecture that best suits the needs of integration, flexibility, scalability, and re-use strategy of the project.

SOA is a set of standards, principles and practices for building software components that are interoperable regardless of the technology used in their implementation. In this sense, SOA goes beyond technologies such as Java RMI or .NET that do not allow interoperability between different software development technologies.

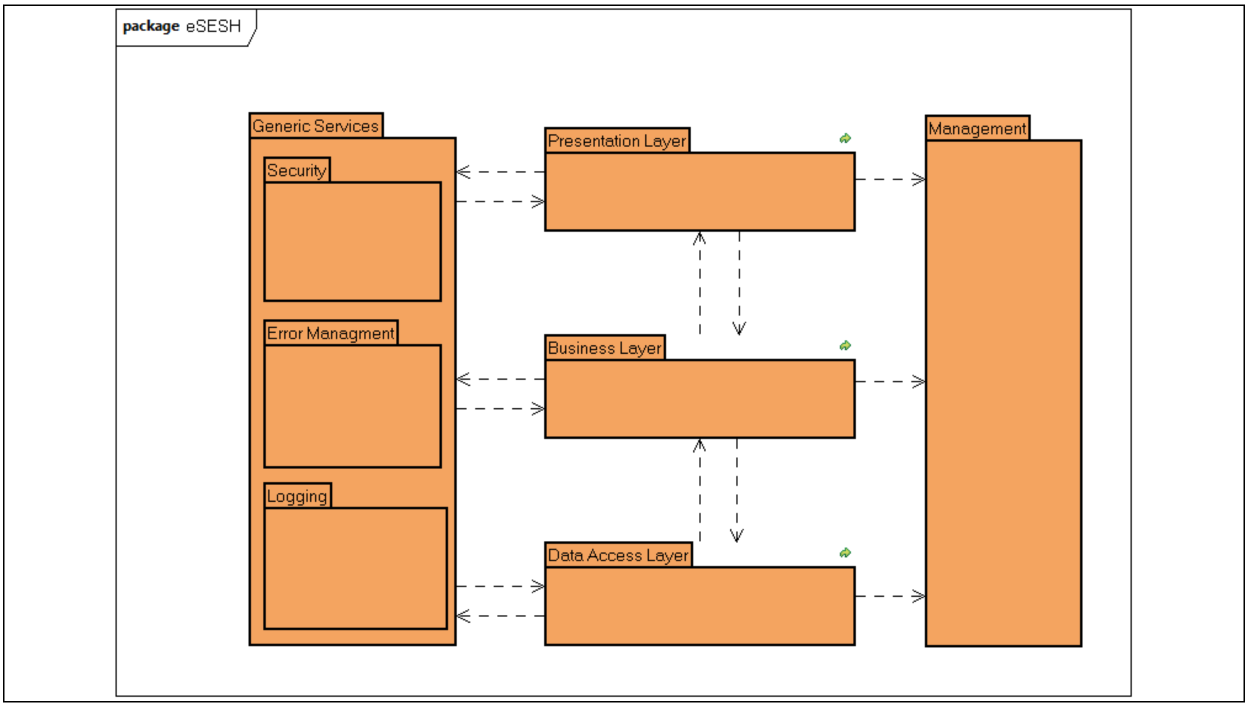
The Service-oriented Architecture (SOA) defines the services that comprise the system, their interactions, and what technologies are to be implemented. Interfaces that use the service to expose its functionality are commanded by contracts that clearly define the set of messages supported, its content and policies. Therefore the key issue of SOA is to motivate the construction of services rather than applications. These services will help to expose a well-defined functionality to applications that need it.

A successful design of a service-oriented architecture should be based on a reliable messaging platform, which isolates the functional implementation from many of the problems mentioned above. Some of the responsibilities of such a device include:

- Guaranteed delivery of messages;
- Routing requests to a service available;
- Security for the content of messages;
- Quality of service (QoS);
- Off-line Scenarios.

The BECA architecture follows a common template based on a generalized three-layer architecture model (Data Access Layer, Business Layer and Presentation Layer), framed by two pillars (Generic Services and Management), see figure below.

Exhibit 15: BECA/eSESH Common Architecture



Whereas the “Generic Services” encapsulate services being related to security issues, error management and logging, “Management” includes all those services which are necessary to configure, maintain and operate the overall system (except the meters which are handled within the Business Layer) itself.

As can been seen the interrelation between “Generic Services” and the different layer as well as the relation between the layers themselves are bidirectional.

The **Data Access Layer** encapsulates all those functions (services) needed for accessing the field components like meters, sensors, communication equipments and so forth.

Possible protocols and standards used for device communication include Zigbee (wireless sensors intra communication), WLAN or radio (868.3 MHz); GMS/GPRS modems, Electrical Net Protocols; M-Bus; PLC; Standard Web Services (SOAP/XML); VPN.

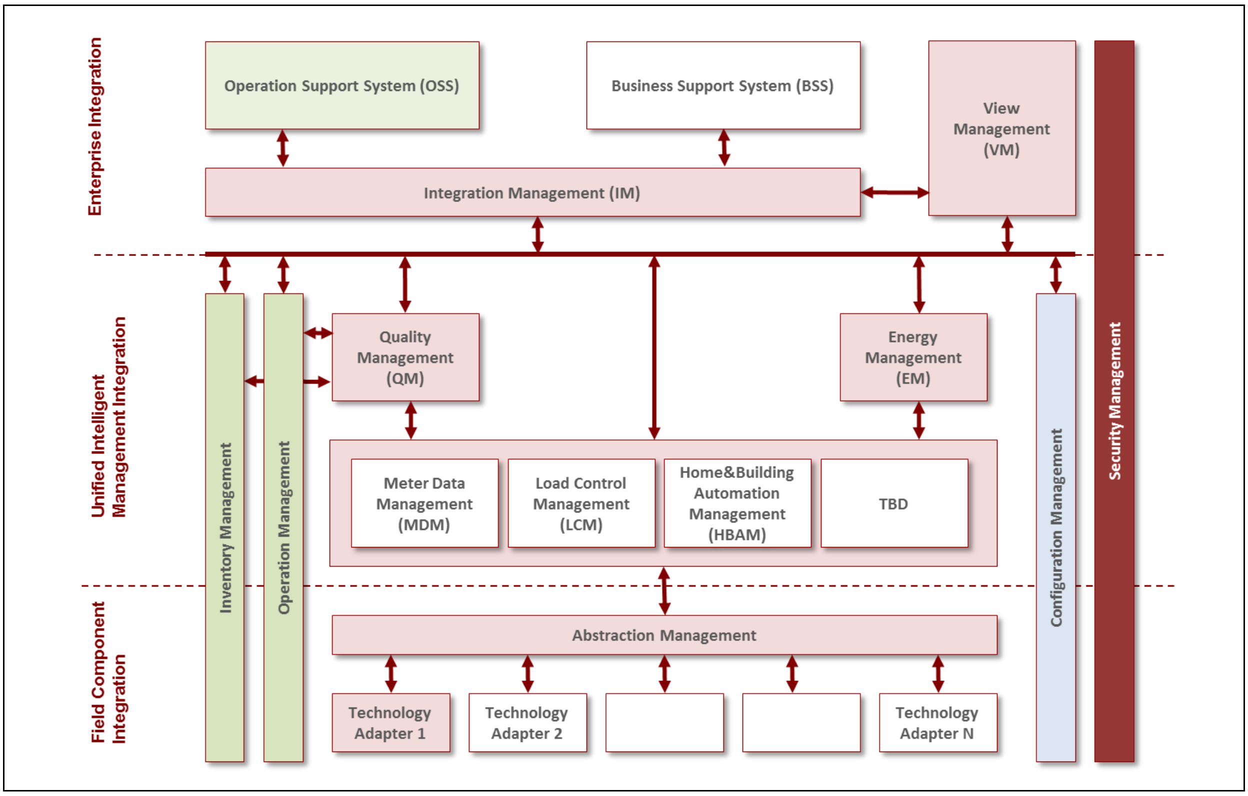
The **Business Layer** focuses on all those services which are related to Energy Awareness or Energy Management. The metering and/or environmental records are provided by the Data Access Layer. Those services can be classified into the following groups:

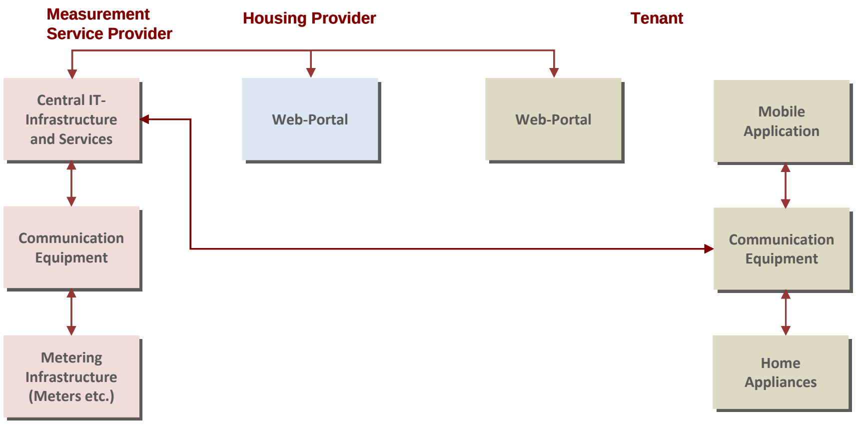
- Tenant consumption, expense and comfort parameters calculations (electricity, gas, thermal energy incl. heating, hot water, solar energy, comfort parameters incl. temperature and relative humidity, cold water, benchmarking with other tenants of the building/pilot);
- Messages and Alarms Systems
- Management Systems.

The **Presentation Layer** encapsulates all those services (functions) which are related to the presentation, i.e. those services related to the user interface (e.g. web-browser, mobile device, room controller).

Exhibit 16 shows a development conceptual diagram of the system as it has been piloted in most of the BECA sites.

Exhibit 16: BECA/eSESH development conceptual diagram



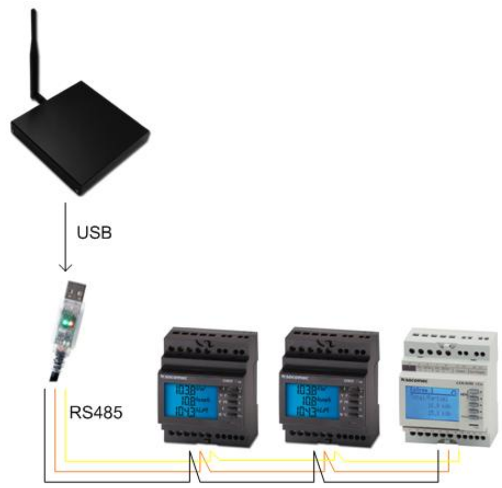


The BECA/eSESH architecture relies, as it is common for most smart-metering approaches, on a set of basic components. To give a short overview of these, the following part describes these and gives examples from BECA pilot sites.

The most obvious component is *metering equipment* being able to measure the current consumption at desired intervals. Wired connections of the metering equipment used (Frankfurt, Solingen, Westerlo, Linz) proved to be very reliable and maintenance is very low. As a general disadvantage, these come with higher installation costs and such technical possibilities do not always exist. Wireless connections on the other hand (Wi-Fi, ZigBee, GPRS) enhance flexibility of installation, but problems with batteries or interferences make them more difficult to maintain, and also require larger time steps for data acquisition.

Depicted on the right are water and heat meters by ista (*istameter* and *ista sensonic II,* used in Frankfurt), which have been natively constructed as smart meters using M-Bus, whereas the third one is a classic membrane gas meter from Catalonia that has been equipped with Kromschroeder's *IR6* in order to

communicate the pulse readings to a data concentrator via a proprietary radio protocol.



The data gathered by individual meters are usually routed to a data concentrator. Dexmatech's DEXGate on the left is an example for such a concentrator and has been used at the Catalonia pilot site. This device supports meters based on the RS-485 Standard and wireless meters using ZigBee or other protocols. In Linz, Echelon's Data Concentrator DC-1000/SL is used, which supports up to 1024 electricity meters and 4096 M-Bus devices connected via PLC. An inbuilt modem converts the serial communication protocols used from the concentrator into standard TCP/IP communication for sending them to a central system. Quite a few data concentrators are available on the market, catering for almost any communication protocol used by metering devices. It is nevertheless advisable to double-check if meters and concentrators are compatible.

Data is then sent to a central IT-infrastructure, where it is processed and stored in databases. This processed data forms the basis for viable information for tenants, be it via the web portal, mobile devices or home appliances.

4.3.6 Scheduling and risk management plan

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

In the implementation schedule to be included in the work plan, you should prepare for sufficient time for each of the five implementation steps, and also take account of the possibility of technical and organisational problems. Even housing companies and utilities that have extensive experience in large-scale pilots experience technical issues when implementing an innovation such as BECA services, and therefore it is better to plan for these to take place.

Piloting within the BECA project indicates that standards described in technical product files are not always kept by manufacturers:

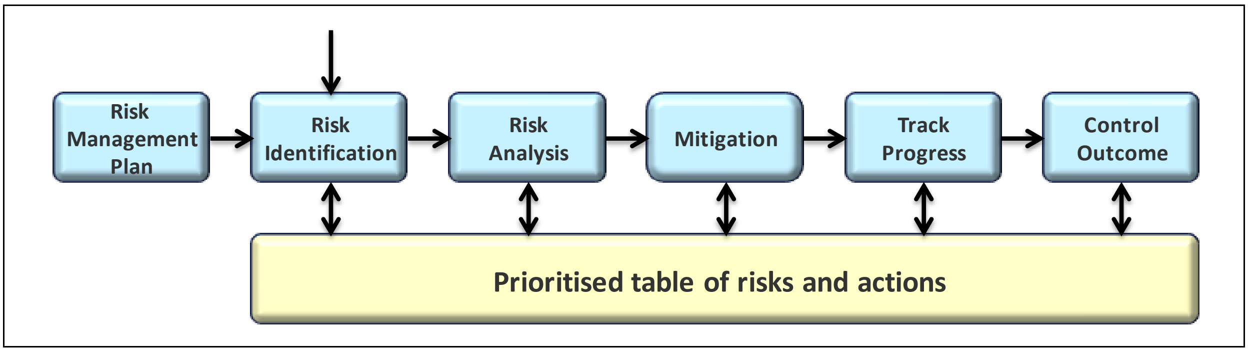
- At the Karlsruhe site, some of the smart meters installed were not able to communicate with the data logger in spite of promises that they would, as they were supposed to use of common protocols. The problem was solved when the meter provider replaced the precursor model of the meter for the latest one which had proven incompatible.
- Since the service start in Extremadura, where gas consumption data is delivered to the tenant portal through an automatic FTP service under agreement between DTES and the gas supplying utility company Gas Natural, communication problems in the utility server kept affected the service for several days.

Such technical can easily impact the timing of the implementation. If installation is delayed, a service which the consumer thought they would receive within months can take a year or more.

In general, the rule is that technical Issues should be kept as invisible to consumers as possible. Successful projects keep these issues from causing consumer's inconvenience (for instance through inaccurate bills) and keep them from endangering the whole roll-out plan, for which reason careful planning and pro-active risk management plans are required.

A detailed plan should be produced for dealing with any major challenges the project can face. It is recommended to apply the classic 4T model: Tolerate, Treat, Terminate, Transfer. The risk management process should consist of a full set of steps to identify risks, analyze and prioritize these, plan mitigation actions, track progress and control outcomes, as illustrated below.

Exhibit 17: Recommended approach to Risk Management



Use the checklist below for documenting your risk management plan. The table has been pre-filled with some of the risks identified when planning for BECA piloting.

Checklist 10: Risk management plan for BECA implementation

Risk	Estimated likelihood	Prevention and Mitigation Plan
Example: Required datasets do not become available at the expected time or quantity.	☐ Low ☐ Medium ☐ High	*e.g.: Involvement of the data owner (e.g. utility, measurement provider) as key stakeholder of the project. Involvement of local/regional government who act as champions of the project.*
Example: The integration effort is much higher than expected	☐ Low ☐ Medium ☐ High	*e.g.: This risk can be mitigated by adapting the prioritisation of system and service features, while ensuring the main objectives of the project and those with industrial relevance are fully achieved.*
Example: Delay in the implementation or deployment of components	☐ Low ☐ Medium ☐ High	*e.g.: The problem is minimised by applying several rounds of prototyping with clear early integration targets. Alternative options for key components should be investigated from the very start.*
Example: Delayed start-up due to resource or communication problems	☐ Low ☐ Medium ☐ High	*e.g.: Early kick-off involving all key partners to check appropriateness of allocated manpower and communication structure. Enable corrective actions if needed.*
Example: Service components too difficult to deploy	☐ Low ☐ Medium ☐ High	*e.g.: All components are to be subjected to usability and functional testing and full documentation should be produced of results.*
Example: Opposition to implementation on the part of a significant number of customers / tenants	☐ Low ☐ Medium ☐ High	*e.g.: Involvement from an early stage on of representatives of tenants in the implementation team. Assignment of an external expert on data protection for advising the implementation team.*

Risk	Estimated likelihood	Prevention and Mitigation Plan
Example: Significant change in the regulatory or commercial environment, seriously affecting business case model	☐ Low ☐ Medium ☐ High	*e.g.: Business case modelling to check for sensitivity to changes of key underlying assumptions.*
Insert additional risks here, based on discussion in implementation team: ...	☐ Low ☐ Medium ☐ High	...
...	☐ Low ☐ Medium ☐ High	...

4.4 Lessons learnt & Recommendations

Lessons are grouped by stakeholder for whom the step is relevant.

4.4.1 Social Housing providers

Category	Issue	Impact	Recommendation
Partnership & buy-in	**S-1** Definition of roles and responsibilities of (sub) contractor / provider avoided conflict and cost.	➔ Hierarchies established avoid additional / unstructured communication ➔ Not allocated tasks, sometimes inducing costs, create conflicts between contractors and can bring work to an halt (potentially with knock-on effects) ➔ The effect was stronger where language barriers exist.	✓ Definitions of key stakeholders and their exact roles in the project must be outlined early on. ✓ Definitions should follow the role/function of the actor within the project, not the structure of the consortium. ✓ Each partner can play several roles, but potential role conflicts need to be identified and subsequently addressed at planning stage.
	S-2 Efforts to clearly allocate responsibility for addressing emerging issues paid off (contingency plans).	➔ Duplication of structures and processes were avoided. ➔ Technical or other problems in the implementation and operational phases were tackled without delays.	✓ Create a risk management table with all foreseeable issues and the process how they are to be dealt with (who, what, in which order). ✓ Make sure all stakeholders understand and agree to the risk management plan.
	S-3 Involve interest groups (e.g. Tenant's associations)	➔ In some countries, negotiations is required to agree upon fees. ➔ Non-inclusion might lead to negative image of service, especially in times of social media.	✓ Ensure transparency about targets and impact upon interest group ✓ Do not side-track regular parties ✓ Prepare proof for long-term
	S-4 Certain data might only be available at public authorities.	➔ In some countries only public utility companies are formally allowed to measure resource consumption ➔ Data collection is directly depending on the willingness of these public authorities to collaborate	✓ Involve the project representatives of public utility companies in the planning phase ✓ Establish agreements with the public utility companies prior to project start ✓ Consider adjustments providing additional benefits for the public utility.
	S-5 Energy / Measurement providers restricted or disallowed access to infrastructure installed at the site.	➔ To implement the service nevertheless, additional wiring or even metering equipment had to be installed. ➔ This added to cost and annoyed tenants.	✓ Contact and involve energy / measurement providers early on. ✓ Make sure that all key stakeholders perceive clear

Category	Issue	Impact	Recommendation
			benefits from taking part in the project. ✓ Also check, however, whether contracts could be given to other providers in the future in case of non-compliance.
	S-6 Energy / measurement providers did (sometimes at short notice) restrict or disallow access to their past and / or current measurement recordings.	➔ Reduced possibilities to offer information services to users, such as time series comparisons. ➔ Lack of data for evaluation of the impacts of service implementation.	✓ Communicate early to secure buy-in; establish a legal agreement on how, when and which data are going to be shared
	S-7 Internal: Technician involvement	➔ 'Specialists' in (group of) buildings able to point out potential barriers for instalment ➔ Non-involvement: Caretakers and other maintenance staff complaint about additional workload ➔ Non-involvement: Responsibilities across departments were unclear and communication lead to new misunderstandings as old processes were disrupted	✓ Collect functional and non-functional requirements for system's implementation. ✓ Collect current inefficiencies to ensure new processes are capable of improving these ✓ Plan training to the service for the staff of the housing company
	S-8 Internal: Administration etc. involvement	➔ Staff aware of and understanding new service does not consider changes as threat or annoyance. ➔ Staff is able to communicate the service as it might reduce future workload	✓ Involve caretakers and other maintenance staff, e.g. through workshops / focus group meetings. ✓ Plan a short coach training to staff of the housing company
	S-9 Coordinate and integrate communal projects / goals aiming to increase energy efficiency, reducing CO_2 consumption etc.	➔ City administrations were actively and publically endorsing energy saving measures in public sector housing found it easier to obtain buy-in from all stakeholders. ➔ Joint development / production of materials / communication strategies reducing costs.	✓ Explore how the implementation fits the city's climate action strategy and (if applicable) local/ regional action plans for energy efficiency. ✓ From the outset, gain support from the city administration. For this, communicate how implementation can play a vital role in meeting the city's climate change policy goals. ✓ Investigate which other local stakeholders may be useful for joining together with to lobby for policy support (e.g. NGOs, unions, individual opinion-leaders).
Take-up	**S-10** Early announcement of BECA implementation raised interest and	➔ Announcing that an advanced energy service would be implemented made tenants curious and	✓ Once the communication strategy has been finalised, create a large-scale poster for building

Category	Issue	Impact	Recommendation
and use	enabled all tenants to learn about the service.	triggered early discussions about what is to come.	facades announcing the service. Ensure content is generic so that it can be re-used in other estates. ✓ Also, include a news item on web-site and, if applicable, magazine published by the company
	S-11 Video material to be used during introduction / exploitation of service	→ Video platforms are on information channel as print materials are for others → Further videos using similar format can also be used as training material. → Helps to identify ‘champions’ and ‘resisting user’ who either can be targeted for further communication, respectively convincing of usefulness.	✓ Keep video under 5 minutes with interviews. ✓ Include interview with a user and show portal. ✓ Make use comment enabled platforms to engage exchange. ✓ Provide sharing features such as ‘like’-buttons and twitter.
	S-12 Printed materials and open meetings are needed to inform users about service	→ Depending on preferred information channel, paper materials remain the most important for some users. → Open meetings help to create trust and transparency	✓ Make sure to have the necessary information brochures and guide materials before service operation start. ✓ Include a contact person in the brochures. ✓ If possible, organise group meetings with tenants for communicating and introducing them with the service before the operation start. ✓ Examine your tenants and split them into groups (e.g. the ones who prefer to receive information via phone, internet, paper, etc.)
	S-13 Inconsistent use of technical terms confused some users	→ Some users voiced confusion when they felt that different terms were used for certain functionalities. → Possibility that some users lost trust and/or interest as a result.	✓ Double-check all communication with tenants to make sure that service related terminology is used consistently.
	S-14 Identification and mobilisation of ‘champions’ in each group of tenants proved very beneficial for smooth implementation.	→ Involving selected users as multipliers improved communication about the service. → This way it helped boost numbers of users and willingness to adapt behavioural patterns of energy consumption.	✓ Identify users who have workable knowledge of heating and electricity systems (e.g. job experience) or are particularly interested in environmental issues. ✓ Give them additional training and involve them in planning. ✓ Consider equipping them with tablets and materials so that they can help neighbours.
	S-15 Choice and provision of	→ Energy Coaches teach users basic energy	✓ Organise fixed times and location for energy coach.

Category	Issue	Impact	Recommendation
	Energy Coaches	efficiencies knowledge and comprehensive use of the service not always existent. ➔ Users have opportunity to ask in person ➔ If users' profile in social environment is not taken into account, they might feel awkward about someone telling them what to do.	✓ Equip social workers with materials and basic knowledge to act as energy coaches capable of referring to experts. ✓ Enter the pilot site friendly **-** Choose carefully the people in charge to contact with tenants ✓ When appropriate, directly approach the heavy consumers detected in cases when you assess that there is no reasons for them to change their behaviour
	S-16 Barriers: It proved difficult to reach and motivate elderly tenants and those with low IT-literacy.	➔ Most of these types of tenants did not make use of the web-service and did, therefore, lack the information to reduce their energy consumption. ➔ Use of unnecessary technical jargon in communication of service deterred some users, especially elderly and immigrants.	✓ Provide paper-based excerpts which can be combined with standard billing. ✓ Increase billing frequency to once every month. ✓ Double-check all communication with tenants to make sure that no unnecessary technical jargon is used.
	S-17 Barriers: Not all users had sufficient access to the internet.	➔ Some users were excluded from using certain features of the service as these require (convenient) access to the internet	✓ Provide PC access points with internet access (kiosk) on the premises of or close to the site. The kiosks can be limited to service of social housing company (which could also be facilitated this way). It could allow access to popular websites such as news sites or social networks to attract tenants. ✓ Consider rolling out internet access to all tenants in parallel with introduction of service.
	S-18 The service targeting heating was scheduled to start just before heating season	➔ Minor delays at some pilot sites meant that here, savings achieved during the piloting phase were lower than what would have been possible.	✓ Make sure that services are ready to use at the start of the heating season, as this is the time when tenants are most open to suggestions for how to modify behaviour to achieve savings.
	S-19 Comparison with neighbours and historic data helped raise attention about the potential for savings and their impact.	➔ Tenants like simple graphs which clearly identify their current performance against the average of the house; some started private "competitions" about who could save most.	✓ Provide, as part of the dashboard on the tenant portal, simple comparisons across time and against averages. ✓ Avoid releasing data at dwelling level, however – use averages across buildings / groups of dwellings instead. Make sure there are more winners than losers since saving should never go below.
	S-20 In some cases, user interest	➔ Number of logins on the web-service declined,	✓ Provision of factual information through smart

Category	Issue	Impact	Recommendation
	in service declined after an initial stage of strong engagement.	making it less likely that tenants stay engaged to reduce their energy consumption.	meters alone will not suffice. Design a long-term strategy for user engagement, including continuous interaction with tenants through a mixture of communication channels.
	S-21 When information was published simultaneously through different communication channels, it proved to be much more effective.	➔ Tenants who were informed through numerous communication channels were found more often to be aware of solution and its functionalities.	✓ Set dates when news items are to be communicated through all available channels. Select dates close to the start of operation to build and maintain momentum.
	S-22 Careful placement of promotional information helped with communication.	➔ Sites in which announcement were published in the entry area using posters or notifications had, on average, a higher share of tenants visiting the online portal.	✓ Consider installing notification board in a public area (e.g. entry hall, staircase, lift) on which relevant news are being pinned on as posters or sheets of paper.
	S-23 Surveys provide user experience helping to set priorities for future developments.	➔ Surveys are source of ideas on how to improve the service from tenants' perspective ➔ Users learn they can contribute or already contributed in further improving the solution	✓ Plan / organise two surveys with users before and after service implementation ✓ Include interviews of selected tenants and / or professionals ✓ Limit the number of questions. ✓ Communicate changes triggered by survey to ensure future participation.
Data privacy & security	**S-24** Survey question can upset users	➔ Questions regarding (energy) subsidies upset tenants and trigger them to complain about survey wrongly associating it with the service.	✓ Verify questionnaires with small set of tenants or tenant's association. ✓ Clearly communicate that surveys are anonymous.
	S-25 Some tenants expressed concerns regarding data privacy.	➔ A number of users declined to sign the data protection agreement, although they were initially interested in the service. ➔ They could therefore not participate in the programme, reducing total savings.	✓ Pro-active communication is a must. Provide an info sheet explaining risks for and rights of tenants using simple language. ✓ In case of signs of concern about the topic, consider involving an independent data privacy/ security expert in project (e.g. consumer advocate). ✓ PR activities should emphasise the efforts being taken to protect data privacy.

Category	Issue	Impact	Recommendation
	S-26 Social workers proved good in communicating the objectives of energy campaigns, and in engaging tenants to take up the service.	➔ Users welcomed advice coming from individuals such as social workers whom they trust to operate in their interest, who stress the economic benefits of energy saving, and who "speak their language".	✓ From the outset involve social services in the project – individuals who have a relationship with users are more likely to be listened to.

4.4.2 IT / Measurement Providers

Category	Issue	Impact	Recommendation
Partnership & buy-in	**I-M-1** Some measurement providers collaborated only tentatively with the project, as they did not perceive significant benefits from involvement.	➔ In some cases, measurement providers restricted or disallowed access to infrastructure installed at the site. ➔ Also, some measurement providers did (sometimes at short notice) restrict or disallow access to past or current measurement recordings.	✓ Measurement providers that have not done so already should devise a long-term strategy how to deal with smart meter-based energy efficiency projects, as there is the risk that they will otherwise be seen as inhibiting factor that should in the longer term be bypassed, i.e. removed from the value chain. ✓ If necessary, set conditions (such as financial compensation for access to data or infrastructure) for active involvement in the implementation project.
	I-M-2 Some energy providers restricted or disallowed access to infrastructure installed at the site.	➔ To implement the service nevertheless, additional wiring or even metering equipment had to be installed. ➔ This added to cost and annoyed tenants.	✓ Contact and involve energy / measurement providers early on. ✓ Make sure that all key stakeholders perceive clear benefits from taking part in the project. ✓ Also check, however, whether contracts could be given to other providers in the future in case of non-compliance.
	I-M-3 Some energy providers did (sometimes at short notice) restrict or disallow access to their past and / or current measurement recordings.	➔ Reduced possibilities to offer information services to users, such as time series comparisons. ➔ Lack of data for evaluation of the impacts of BECA implementation.	✓ Communicate early to secure buy-in; establish a legal agreement on how, when and which data are going to be shared
	I-M-4 After installation, it is important that all meters are tested and evaluated before starting with	➔ Any potential malfunction or error can damage the credibility of the system.	✓ Implement standardise testing procedure.

Category	Issue	Impact	Recommendation
	system operation		
Take-up and use	**I-M-5** Well-designed online portals help raising interest among young and tech-savvy tenants.	➔ Children and young adults positively welcomed certain features of the online portal, spending more time on BECA and often communicating experiences to relatives	✓ Make sure that the service runs on (new) media devices such as game consoles; provide material such as comics or characters appealing to children even if they are not (yet) the immediate target audience.
	I-M-6 Offering the energy portal as part of a smart home application helps raise tenants' interest.	➔ Rather than working as stand-alone applications, at some sites the portal and energy management apps were combined with smart home features into a control centre for the home. ➔ This made the system more desirable in the eyes of many tenants.	✓ Consider services as an entry point for cloud-based services which go beyond mere metering services and include home control features which, in turn, can help keep users interested and exposed to energy-saving related information
	I-M-7 Not all tenants had sufficient access to the internet.	➔ Some tenants were excluded from using certain features of the service as these require (convenient) access to the internet	✓ Assess, at an early stage during the preparatory stage, spread of internet access and uptake in your target group, e.g. using a questionnaire survey (a random sample may be sufficient). ✓ Provide PC access points with internet access (kiosk) on the premises of or close to the site. The kiosks can be limited to BECA and services of the social housing company (which could also be facilitated this way). It could allow access to popular websites such as news sites or social networks to attract tenants. ✓ Consider schemes for rolling out internet access to all tenants in parallel with introduction of BECA. This may require funding from external sources (e.g. network provider).

Category	Issue	Impact	Recommendation
	I-M-8 It proved difficult to reach and motivate elderly tenants and those with low IT-literacy.	➔ Most of these types of tenants did not make use of the web-service and did, therefore, lack the information to reduce their energy consumption.	✓ Check all interfaces and online services for accessibility using the latest standards, e.g. Web Content Accessibility Guidelines[4]. ✓ Check all promotional and communication materials for use of clear and plain language.
Data privacy & security	**I-M-9** Some tenants expressed concerns regarding data privacy.	➔ A number of tenants declined to sign the data protection agreement, although they were initially interested in the service. ➔ They could therefore not participate in the programme, reducing total savings.	✓ During the design and implementation phases, check all services to make sure that personal data are treated according to accepted data privacy standards. ✓ In the case that users can be expected to have concerns about this issue, consider involving an independent data privacy/ security expert in project (e.g. consumer advocate). ✓ If appropriate, develop versions of the services which collect less data (even if this would limit functionalities), to be prepared for the case that the preferred solution cannot be implemented because of tenant opposition.

4.4.3 Energy providers

Category	Issue	Impact	Recommendation
Partnership & buy-in	**E-1** Some energy providers collaborated only tentatively with the project as they did not perceive significant benefits from involvement.	➔ In some cases, energy providers restricted or disallowed access to infrastructure installed at the site. ➔ Also, some energy providers did (sometimes at short notice) restrict or disallow access to past or current measurement data.	✓ Stakeholders measuring data that have not done so already should devise a long-term strategy how to deal with smart meter-based energy efficiency projects, as there is the risk that they will otherwise be seen as inhibiting factor that should in the longer term be bypassed, i.e. removed from the value chain. ✓ If necessary, set conditions (such as financial compensation for access to data or infrastructure) for

4 See http://www.w3.org/WAI/

Category	Issue	Impact	Recommendation
			active involvement in the implementation project.
	E-2 Some energy providers restricted or disallowed access to infrastructure installed at the site.	➔ To implement the service nevertheless, additional wiring or even metering equipment had to be installed. ➔ This added to cost and annoyed tenants.	✓ Contact and involve energy providers early on (if applicable).
	E-3 Some measurement providers did (sometimes at short notice) restrict or disallow access to their past and / or current measurement recordings.	➔ Reduced possibilities to offer information services to users, such as time series comparisons. ➔ Lack of data for evaluation of the impacts of BECA implementation.	✓ Communicate early to secure buy-in. ✓ Establish a legal agreement on how, when and which data are going to be shared.
Take-up and use	**E-4** In some cases, tenant interest in BECA services declined after an initial stage of strong engagement.	➔ Number of logins on the web-service declined, making it less likely that tenants stay engaged in efforts to reduce their energy consumption.	✓ Provision of factual information through smart meters alone will not suffice. There is a need for a long-term strategy for user engagement, including continuous interaction with tenants through a mixture of communication channels.
	E-5 The service targeting heating was scheduled to start just before heating season	➔ Minor delays at some pilot sites meant that here, savings achieved during the piloting phase were lower than what would have been possible.	✓ Make sure that services are ready to use at the start of the heating season, as this is the time when tenants are most open to suggestions for how to modify behaviour to achieve savings.
	E-6 Comparison with neighbours and historic data helped raise attention about the potential for savings and their impact.	➔ Tenants said they liked simple graphs which clearly identify their current performance against the average of the house; some started private “competitions” about who could save most.	✓ Provide, as part of the dashboard on the tenant portal, simple comparisons across time and against averages. ✓ Avoid releasing data at dwelling level, however – use averages across buildings / groups of dwellings instead. Make sure there are more winners than losers since saving should never go below.
	E-7 It proved difficult to reach and motivate elderly tenants and those with low IT-literacy.	➔ Most of these types of tenants did not make use of the web-service and did, therefore, lack the information to reduce their energy consumption. ➔ Use of unnecessary technical jargon in communication of BECA service deterred some tenants, especially elderly and immigrants.	✓ Provide paper-based excerpts which can be combined with standard billing. ✓ Increase billing frequency to once every month. ✓ Involve a communication specialist to adapt the design and language of the printed bill so that it is attractive to read and easy to understand by every-

Category	Issue	Impact	Recommendation
			body.
Data privacy & security	**E-8** Some tenants expressed concerns regarding data privacy.	➔ A number of tenants declined to sign the data protection agreement, although they were initially interested in the service. ➔ They could therefore not participate in the programme, reducing total savings.	✓ During the design and implementation phases, check all services to make sure that personal data are treated according to accepted data privacy standards. ✓ In the case that users can be expected to have concerns about this issue, consider involving an independent data privacy/ security expert in project (e.g. consumer advocate).

4.4.4 City administration / social service providers

Category	Issue	Impact	Recommendation
Partnership & buy-in	**C-1** Support from city administrations can be essential for the success of implementation.	➔ Pilot sites where city administrations were actively and publically endorsing energy saving measures in public sector housing found it easier to obtain buy-in from all stakeholders.	✓ Explore how the implementation can contribute to the city's climate action strategy and (if applicable) local/ regional action plans for energy efficiency. ✓ Check whether it is possible and useful to combine BECA implementation with local strategies for e-inclusion and/or countering fuel poverty. ✓ Make sure that the project does not exclude tenants who do not use the internet and/or lack the ability to understand the information transmitted by BECA end devices.
	C-2 Changes in regulation of billing and relevance of ICT-services	➔ Some countries are to change current energy bills based on surface area to consumption based billing ➔ Greater involvement and concern of users with regard to energy efficiency and ICT-solution ➔ Chance for SMEs to enter the market	✓ Adopt country policies and regulation in line with the potential benefits derived from the BECA solution ✓ Take necessary measures in assuring an appropriate environment for the implementation of ICT-services ✓ Highlight benefits resulting from service usage apart from compliance
Take-up	**C-3** Social workers proved good in	➔ Tenants welcomed advice coming from individuals	✓ Discuss with social service agencies how their staff

Category	Issue	Impact	Recommendation
and use	communicating the objectives of energy campaigns, and in engaging tenants to take up the service.	such as social workers whom they trust to operate in their interest and who "speak their language"	can be involved in the efforts to reduce energy consumption and fuel poverty in social housing. ✓ Provide basic training (on energy efficiency, fuel poverty, end devices) to social workers who are to support tenants in preparation of and during BECA implementation.
	C-4 Service implementation benefits from public Wi-Fi infrastructure	➔ Where all tenants had free access to the internet through a public Wi-Fi, they were making more use of the BECA energy portal. ➔ The EAS can be used as a means to attract tenants to develop their digital literacy skills.	✓ Explore possibilities for providing social housing tenants with free internet access, e.g. through a public Wi-Fi infrastructure or a city-wide public access network.
Data privacy & security	**C-5** Some tenants expressed concerns regarding data privacy.	➔ A number of tenants declined to sign the data protection agreement, although they were initially interested in the service. ➔ They could therefore not participate in the programme, reducing total savings.	✓ Check possibilities for involving an independent data privacy/ security expert in the implementation project (e.g. consumer advocate), which would also give city administration better insight into the privacy and security implications of BECA service. ✓ Local PR activities should emphasise the efforts being taken to protect data privacy.

4.4.5 Tenants

Category	Issue	Impact	Recommendation
Partnership & buy-in	**T-1** At pilot sites where there is a history of initiatives around energy saving, smart meter technologies were particularly welcomed by tenants.	➔ Strong interest among tenants, high rates of uptake. ➔ Low average levels of energy consumption per dwelling, inhabitant and square meter.	✓ Implementation should not take place as stand-alone measure, but embedded in long-term, continued activities for raising awareness about energy efficiency. ✓ Request information on the long-term strategy for energy efficiency of the housing company and energy provider.
	T-2 Tenant involvement during service design proved to be vital for the success of implementation.	➔ Focus group meetings with tenants helped to identify which service features are most likely to be successful. ➔ Serious involvement in the project from an early	✓ Ask for meetings already at preparatory stage to gain a full understanding of the programme and to discuss open issues. ✓ Request that a representative of the tenant

		stage onwards made it easier to obtain buy-in also from sceptical tenants.	association participates in meetings.
Take-up and use	**T-3** Organised workshops and trainings resulted helpful in improving tenants' ICT knowledge.	➔ After training greater number of users begin to use portal ➔Users with difficulties in using IT technologies were grateful for organised workshops ➔ Users felt certain responsibility to participate in other project activities	✓ Assess your users' background and organise training / workshop sessions for tenants lacking ICT knowledge. ✓ Provide tenants with energy coaching and continuously contact tenants' representatives.
	T-4 Personalised energy advice proved effective in helping tenants adapt their behaviour.	➔ Reduced energy consumption ➔ Smaller utility bills ➔ Way to prevent fuel poverty ➔ Increased motivation to use the service and change consumption behaviour	✓ Request practical advice that can effectively help reduce energy consumption. ✓ Use of data on automatically detected patterns of consumption should only be made when the tenants opts for it (opt-in). ✓ Improve your guidelines. Provide estimation on how much energy can be saved by taken measures.
	T-5 Complexity of graphs used	➔ Users fail to understand graphs shown on default if too many colours / contexts. ➔ Users fail to comprehend adjustments of periods and the effects upon the graphs.	✓ Reduce number of options to the bare minimum ✓ Ensure simplicity of language used as much as consistency (e.g. location of graphs) across resources. ✓ Provide an expert section for users with more interest
	T-6 Not all tenants had sufficient access to the internet / sufficient ICT equipment.	➔ Some tenants were excluded from using certain features of the service as these require (convenient) access to the internet	✓ Request that all tenants have access to the benefits to be derived from implementation, as far as possible. ✓ Request schemes for rolling out internet access to all tenants in parallel with introduction of service. ✓ Request PC access points with internet access (kiosk) on the premises of or close to the site. The kiosks can be limited services of the social housing company (which could also be facilitated this way). It could allow access to popular websites such as news sites or social networks to attract tenants
	T-7 It proved difficult to reach and motivate elderly tenants and those with low IT-literacy.	➔ Most of these types of tenants did not make use of the web-service and did, therefore, lack the information to reduce their energy consumption.	✓ Request that feedback is also supplied in paper-based format (possibly combined with monthly bill) to make sure that all tenants are reached.

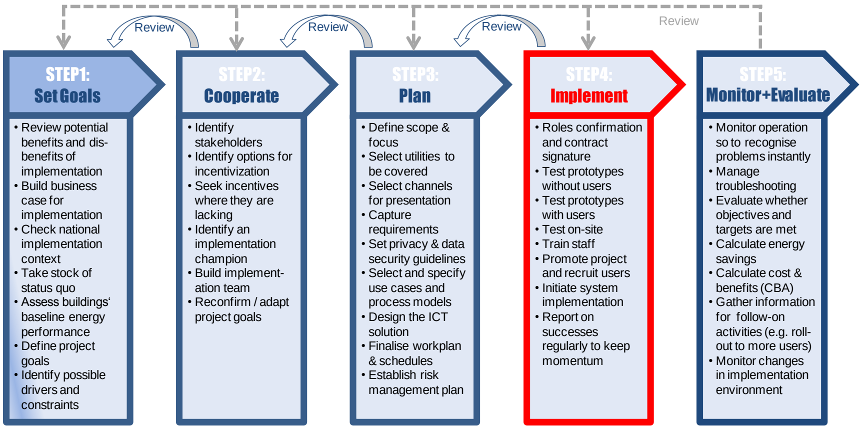
		➔ Use of unnecessary technical jargon in communication of BECA services deterred some tenants, especially elderly and immigrants.	✓ Prepare brochures on know-how about web portal ✓ Request that bills are easy enough to understand by all tenants, including immigrants.
	T-8 Face-to-face meeting with users	➔ Help achieving positive results during user recruitment, after joint meetings have been organised and informational and educational materials have been distributed ➔Makes possible to get full picture about real situation and potential barriers	✓ Talk to people in person by organising face-to-face meetings even though it might require some time efforts. ✓ Pay them personal attention and make tenants continuously feel part of the project.
Data privacy & security	**T-9** Some tenants expressed concerns regarding data privacy.	➔ A number of tenants declined to sign the data protection agreement, as they were concerned about data privacy. ➔ They could therefore not participate in the programme, i.e. not benefit from the savings enabled by the system.	✓ Request that comprehensive and clear information is given about data privacy and security issues, and that adequate measures are taken to prevent mishandling of data and security breaches. ✓ Ask for involvement of an independent data privacy/ security expert in project (e.g. consumer advocate).
	T-10 Social workers proved good in communicating the objectives of energy campaigns, and in engaging tenants to take up the service.	➔ Tenants welcomed advice coming from individuals such as social workers whom they trust to operate in their interest, who stress the economic benefits of energy saving, and who "speak their language".	✓ Press for involvement of trusted "middlemen" such as social services workers and representatives of tenants associations to make sure your interests are properly reflected in the implementation process.

5 Implement the service

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

Section	Title	Social Housing	City Council	IT-provider	Measurement	Energy provider	Social Services	Tenants	Policy Maker
6	***Implement the service***								
6.1	**Roles confirmation and contract signature**								
6.2	**Test the system**								
6.2.1	Prototype testing								
6.2.2	On-site testing								
6.2.3	Lessons learned & Recommendations								
6.3	**Staff training**								
6.4	**Promotional activities and user recruitment**								
6.4.1	eSESH Promotion								
6.4.2	User recruitment								
6.4.3	Lessons learned & Recommendations								

The service implementation stage comprises the following core activities. Firstly, it needs to be made sure that all **roles** are properly defined and the required **contracts between stakeholders** signed. Secondly, **technical tests** of service components need to be carried out (a) without involving users; (b) with tenants and other users. Thirdly, **on-site piloting** within selected dwellings is used to test all services before going live. In parallel, **promotional activities** and **recruitment of tenants** need to take place through suitable channels, and provider staff needs to be trained, also to make sure that an adequate response can be given to customer enquiries throughout every stage of the project. Finally, **system implementation** needs to be initiated.



5.1 Roles confirmation and contract signature

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

Ensure that all required roles are properly covered and reflected in formal agreements or contracts, as applicable. For checking roles see Checklist 6 on page 54, which you should have completed in the planning stage already.

Formal agreements should also be made about the deadlines for service provision and finalisation of activities, see Checklist 11 below.

Checklist 11: Preparation of installation & operation

Activity	Building 1	Building 2	Building ...	Comment
Prototype testing without users				
Prototype testing with users				
Dwellings: Equipment installation (a) (e.g. meters)				
Dwellings: Equipment installation (b) (e.g. wiring)				
Buildings: Equipment installation (a) (e.g. concentrators)				
Buildings: Equipment installation (b) (e.g. wiring)				
Distribution of Consent forms				
Collection & validation of consent forms				
Selection of site for on-site testing				
On-site testing				
Feedback platform (e.g. Web portal) going online				
EAS: Pilot Operation Start				
EMS: Pilot Operation Start				
add any other relevant activity here ...				
...				

The table above lists the key activities to be completed during the implementation stage. Each of these is discussed in more detail in the following.

5.2 Test the system

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

For testing the system to be implemented, it is important to define the scope in advance. This includes the following factors, to be documented in a **pilot test plan**. This should comprise the **Dimensions** tested:

- Usability;
- Functionality;
- Perceived utility from system users' viewpoint.

Testing results in **validation of both use cases and process models**, as listed in section 4.3.4 and in the annex (chapter 7).

The test plan should also define the process of **Recruitment of test persons** from the BECA target groups:

- Tenants;
- Social housing staff;
- Energy provider staff.

It is desirable to involve several members of each group in the test process either individually (individual testing) or as groups (joint testing). The recruitment process is discussed in more detail below (chapter 5.4).

Prototype set-up: Typically, the prototype technology to be tested is the visualisation of energy data to tenants, property managing and energy services companies through energy awareness system applications (such as web portals, mobile apps, in-home displays, etc) and/or energy management systems.

Test Regime – Walk-through with use cases: Prototype testing is carried out as walk-through using the prototypes developed and the use cases developed (see section 4.3.4) defining typical uses of the prototype systems and the related processes from the process models. Participants should be invited and encouraged to ask questions and comment at appropriate stages along the way. After completion of the demonstration/walk-through an open discussion should be encouraged where the participants have the opportunity to ask further questions to the presenters and together with the presenters elaborate on specific system features of interest.

Location: There are various options for where testing to take place. The selection of an appropriate location should take into account:

- Availability of technical infrastructure;
- Number of participants;
- Time available;
- Accessibility.

Below, the two main phases of testing are discussed in more detail: Prototype testing and on-site testing.

5.2.1 Prototype testing

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

For prototype testing, test protocols based on the defined use cases are drawn up. The implemented test prototype is subjected to laboratory based testing:

- firstly **without users**, for which purpose end-user and staff input is simulated or generated automatically as appropriate;
- secondly **with users** from all target groups (tenants, social housing staff etc.).

The prototype is aimed to provide system users with a detailed view of the proposed system solutions in order to provide feedback on their usability, functionality and an assessment of the value for system users. Results help to drive system implementation to ensure successful start of pilot operation.

The test plan should provide all use case diagrams and descriptions for energy awareness services (EAS) as well as for energy management services (EMS), as prepared in the planning phase (see section 4.3.4). Besides the use cases also the requirements following from user characteristics (see Exhibit 9) typically not documented in the use case descriptions – should be tested on-site.

Additional documentation may be needed to describe the specific use case in more detail.

Feedback from the sessions needs to be collected in a structured format. For this purpose, a user questionnaire should be developed for gathering feedback from test users, containing questions on the user experience and covering all applicable use cases. Make sure to use closed questions (i.e. multiple response) wherever possible but also plan in open questions to allow for response about issues not foreseen by the developers. For every use case test persons are asked to:

- Run through the steps comprising the specific use case;
- Provide feedback on their experience using a Likert scale (e.g. from 1– very low to 5 – very high) and separately for usability, functionality and utility;
- Provide feedback on any features missing from a user perspective;
- [for system providers only] Provide feedback on integration of the new solutions with existing systems to be retained and operational/business processes;
- Add further notes in free-form text, containing remarks, suggestion, etc. (optionally).

User statements and test results will then be fed back into the evaluation and (if necessary) final development process.

5.2.2 On-site testing

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

The on-site test represents the final test phase in which all the functional and non-functional requirements should be addressed in the prototype system implementations to be tested. To do so, the generic used case diagrams and descriptions are to be adapted to the implementation context.

Whereas the prototype testing phase focuses on some specific aspects of the systems behaviour, on-site testing is aimed to provide a comprehensive overview on the fulfilment of almost all the requirements defined at earlier stages of the implementation project. In order to guarantee smooth operation the testing is designed to reveal problems that might arise from the particular situation of equipment, communication networks, and the organisational environment in which the service staff work. On-site testing follows a similar methodology as prototype testing, but the applications run with data from the installed metering equipment in real pilot operation.

On-site testing should be carried out by the equipment/ICT provider in cooperation with key service provider / housing staff. A reporting template has to be developed to allow pilot managers to report on the testing of the following key issues:

- Test of the **measuring equipment correctness** after installation at pilot site. Incorrect measurements may result from faulty installation, equipment failure or unacceptable bias. For this a number of checks have to be performed, e.g. comparison of readings of installed meters with that of the utility over a certain period; cross-check measurements using portable network analysers, etc. Heat metering measurement correctness can be verified using cross-comparison of main and individual meters. Heat cost allocators do not directly measure heat flows and cannot be compared explicitly for correctness at the pilot site, so their accuracy should rely on approved quality procedures of the manufacturers and suppliers of these devices.
- Test the **connectivity of pilot site equipment**. This includes the check for user account configuration to visualise the correct data to the correct user (data mapping), the capability of the system to detect communication failures and the data storage capacity (buffer time) of the data acquisition equipment in case of communication failure. The appropriate configuration of the system is checked to avoid problems with data loss during operation.
- Test of **service applications** at pilot site level. The testing of the application at pilot site level should be performed by the pilot operating staff following the methodology described in the previous point, in order to serve as a final approval.
- Test of the **organisational environment for service operation**. The roles of each participant in the service at the pilot site are clearly outlined and their preparation for service is reported. A set of common operational problem scenarios is checked in order to test the preparation of the pilot organisation for service delivery.

The results are then summarised in order to calculate average level of satisfaction for each use case. Further improvements focus on addressing testers' feedback and improving the implementation of the use cases that they were less satisfied with.

Based on these use case definitions the functional tests are executed. The results of those tests can be documented by using a table format such as follows (one table per use case).

Exhibit 18: Test case documentation

Test Case	**Unique Identifier of Use Case**
Describe Results (Screen Shots)	
Comments:	
Fulfilment [%]	e.g. 20%
Open Activities:	Describe all the activities being necessary to achieve a Fulfilment of 100%.

Since functional requirements only represent one side of the coin, identified requirements following from user characteristics should also be tested.

5.3 Staff training

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

In parallel with promotional activities and user recruitment, housing company staff and any other staff which is to contact customers for the purpose of BECA implementation needs to be adequately trained.

Well informed employees who interact with tenants play a key role for the success of the implementation. When in contact with consumers, staff should be able to answer standard as well as site-specific questions. There should also be a thorough understanding about the benefits of smart metering to all parties concerned, as well as a common vision revolving around responsibility for the environment and commitment to the interests of tenants – especially if these are households at risk of fuel poverty.

Type and scope of staff training can take several forms and depends on the services to be implemented. Of course, **technical staff** needs to be trained in any new system to be implemented. Importantly, **housing company employees** who are in direct, day-to-day contact with tenants need to be trained as tenants are most likely to approach them first when they experience problems or have open questions. Back-office staff will need to understand the system so that they can administer changes of customer data, for instance when tenants move out or in. The **staff installing the meters** should be properly trained as well so that they can answer consumers' questions but – importantly! – also communicate the advantages of the technology rather than contribute to feelings of concern and uncertainty.

5.4 Promotional activities and user recruitment

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

For promotion of BECA implementation, it should be stressed that customers (future users) will need to be well prepared before they can be expected to start using the services on offer. As a survey of international best practice of smart meter enabled energy efficiency and demand response systems, conducted by VaasaETT, found: "The inter-play of outstanding pre-offering, pre-technology education, especially from independent sources is an extremely important way to prepare consumers for the programme to come. As a first step, a consumer must see the bigger picture, the reason why the utility is embarking on this action, why the customer should be interested and why the community should be working together. Only then should technology be introduced. It is after all, not the technology that is the objective; it is only a means to an end."[45]

5.4.1 BECA Promotion

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

A wealth of research has shown that a private household's patterns of energy use are determined by energy costs and information/awareness about these, as well as by social, educational and cultural factors. The latter can play an important role, as energy traditionally has important symbolic and behavioral aspects. In many people's minds, energy "rationing" is a negative symbol of hard times, whereas energy consumption is a sign of prosperity. This appears to be true, in particular, for low-income social environments as they are the norm in less developed countries[46]. On the other hand, more widespread concern for the environment in affluent societies has tended to boost energy-saving behaviours. Saving energy therefore carries ambiguous connotations, which need to be taken into account when designing measures for changing energy use behaviours of tenants in residential buildings.

The challenge is to affect behaviour permanently. Information and education are key elements to change knowledge into action. This includes advertising campaigns on energy efficiency, the relative energy consumption of types of appliances, advice on energy efficient equipment or behaviour, and how better possibilities for real-time feedback can make a big difference in daily life.

Consumers tend to be aware already that there is a trade-off between energy-saving and loss of comfort. They now need to be empowered to choose actions for saving energy that come with minimal impact on their comfort. For this, BECA energy awareness and management services play a huge role.

Promotion messages can take many forms but tend to focus on three issues: reasons to be positive about the new developments, reasons to get involved and the elimination of reasons not to get involved.[47]

Possible reasons to be positive about the new developments include:

- Cost savings;
- Contributing to protection of the environment;
- Future possibilities (products, services) enabled by the smart metering infrastructure, most of them having to do with consumer empowerment;
- Other benefits of the smart meter, such as more accurate consumption measurement leading to fairer utility billing.

Reasons to get involved can include:

- Help the housing company or utility to provide better services for you and everyone;
- Individual actions, however small, are part of something;
- Opportunity to benefit the environment;
- Opportunity (not promise) to save money;
- Opportunity to better manage and understand energy costs and bills;
- Receipt of energy usage reports;
- Financial reward for participation, if applicable;
- Receipt of a free smart meter;
- Receipt of an in-home display;
- Receipt of a free communication device, e.g. tablet (as in BECA Westerlo pilot);
- Receipt of education (including also tips) on how to reduce consumption and costs;
- Added home comfort and convenience (e.g. home energy management system);
- More convenient time-of-use tariffs (only appropriate for customers already on time-of-use tariffs).

Reasons not to get involved tend to include the following:

- General doubts about the service providers' good intentions;

- Lack of understanding of the goals behind the implementation;
- Lack of understanding of how the service works in practice, and what its practical implications are in daily life;
- Housing organisation or utilities perceived as “Big Brother” who seeks to spy on tenants and/or wants to sell customer data to third parties;
- Perceptions of lack of security if tenant data are lost or stolen by criminals, etc.;
- Presumptions that the provider will charge for the service, if not from the start then maybe later;
- Opposition to the project as an occasion to complain about some other misgivings (e.g. staircase always dirty, other tenants are making noise, etc.);
- Doubts whether energy savings can be achieved without serious loss of comfort.

Elimination of reasons not to get involved can mean:

- Ease of use, e.g. plug and play or automation to make it simpler;
- Promises (preferably guarantees) that the housing provider or utility is trying to help you the consumer;
- Promise of excellent customer support and hands-on help if demanded;
- Right for you the consumer to opt-in and leave the programme;
- Assignment of an independent expert on data protection who is responsible for defending your, the consumer’s interest concerning data privacy and security;
- Answers to any other questions from you, the consumer.

Standard **means of promotion** are **websites** and **tenants meetings**, both of which need to be well prepared and carefully managed to communicate the “right” messages.

Other means for promotion can include the following:

- Educational **leaflets or brochures** are useful for generic pre-implementation overview of the offering and the reasons behind it: They are typically around just two pages in length, extremely clear in language and presentation style and aesthetically pleasing. The example to the right is from the eSESH pilot in North Italy.
- **Longer brochures and reports** may be appropriate for addressing professionals and customers with an interest in detailed explanations.
- **Posters** are well-suited for raising awareness and guiding interested users to sources of additional information, e.g. a web site or a public information session. Place them were tenants cannot fail to notice them, e.g. in building entrances, elevators or staircases. The example to the right is from the eSESH pilot in Extremadura.
- Participation in **exhibitions** and **fairs** is good for reaching professionals and possibly also the wider

interested public in case of fairs targeting the consumers in general.

- **Press conferences** are a means to mobilise the local or regional media to report about the project. They require careful preparation as the implementation team needs to be able to give persuasive responses to any kind of critical questions that might be asked. The photo to the right is from the press conference given for announcing start of the eSESH pilot in Extremadura.
- **Promotional video clips**: Very good experience has been made in eSESH with use of short films for addressing large audiences, not limited to heads of households. Available on the web, these clips can also be watched by anybody else interested in the topic, not only tenants of the buildings themselves. For the eSESH site in North Italy, an animated cartoon video was produced by in 2011 featuring a family and the other parties involved and explaining the basics of saving energy at home. Available in English or Italian, the video also maps out the main steps of service implementation with the objective to raise support for the project.

A word of warning is in order here. Promoters should resist the temptation to make excessive promises regarding the energy and cost savings to be expected from project implementation. **Expectation management** should be a key objective of any promotional activity. Successful roll-outs are supported when the project's promises and delivery are aligned. Promotion activities should also stress the fact that the new technology is mainly an enabler of cost savings, but that tenants are responsible for change of their day-to-day consumption behaviour.

5.4.2 User recruitment

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

The methodology for tenant recruitment should be based on the practical situation at the implementation site, e.g. the state of knowledge about ways to save energy and the quality of the relationship between housing company and tenants. For a pilot project, it is useful to tenants from different customer groups according to educational attainment, age group, household structure and possibly ethnical group.

Invitation letters are an important part of the recruitment process, but so are communication through word of mouth and practical demonstrations of the value of smart meter data as well as the look & feel of the devices themselves. This is because, as we know from experience with diffusion of technical innovations in general, "people like to explore, they like to discover, in general more than they like to study or be taught"[48]. The photo on the left-hand is from the eSESH pilot in Linz were tenants were invited to check out the smart meter devices and discuss with technical staff from the housing company.

The table below represents an example of the recommended process of user recruitment, consisting of meetings in person and use of dissemination material.

Exhibit 19: Tenant recruitment

Meetings	**FIRST PERSONAL APPOINTMENT** at home with an energy coach *The motivation of the tenants will come from the positive "word of mouth" conveyed by the energy coach. This is the reason why the quality of the energy coaching and training needs to be proved.*	During the encounter the energy coach : - gives precise comparative analysis of the monthly energy budget and the energy saving potential of the tenants - checks the electrical household equipment with respect to energy class and options for programming - provides an analysis from the internet portal (behaviour linked to consumption, electric subscription) *The energy coach does not use the portal but helps tenants to use it. That is why the energy coach is looking carefully to the tenant's behaviour in order to identify points of improvement of the portal, if necessary.* - gives training on how to use the portal - defines a strategy with the tenants how to reduce their energy consumption
	SECOND PERSONAL APPOINTMENT at home with an energy coach	Another encounter is planned two months after to evaluate the first results, in comparison to the adopted personal strategy *It will be necessary at this stage to keep an eye on the tenants who reduced their consumption permanently in order to find reasons for this.*
	CONTINUOUS CONTACT: The energy coach is available for interactive phone assistance if necessary	For example to help tenants using the web portal.
	The "awareness game"	Several meetings with groups of about eight tenants to practise the "awareness game", a playful way to learn more about how to save energy and water.
Dissemination material	**FIRST CONTACT:** personal letter to every tenant	The letter contains: - the portal access code - information about the possibility to contact an energy coach - an invitation to the "awareness game"-meeting - information about a monthly brochure which contains the consumption of each flat This letter tries to motivate tenants attending the project by giving them information about the personal estimated energy saving potential of the family. The tenants have to return the free reply-coupon with the options selected.
	SECOND CONTACT: Complementary phone call to tenants identified as those with "low incomes and high energy expenditures", who did not	After sending this letter the energy coach will collect the consumption data for each flat together with data on the income of the tenants. This will identify tenants who are

	respond to the letter This call will result in a meeting	in need of saving money most in order to develop a specific approach to work with them on saving energy.
	Energy consumption personal report – sent monthly	The report provides the energy consumption information of the tenants - extract from the internet portal - and benchmarks the information
	Quarterly articles in the local press	These articles will allow tenants to be informed and “re-informed” of the BECA service
	Quarterly articles on the LTA website	These articles will allow tenants to be informed and “re-informed” of the integrated service developed of the eSESH service

5.5 Lessons learnt & Recommendations

Lessons are grouped by stakeholder for whom the step is relevant.

5.5.1 Social Housing providers

Category	Issue	Impact	Recommendation
Technical set-up	**S-27** Tenant involvement during service design proved to be vital for the success of implementation.	➔ Focus group meetings with tenants helped to identify which service features are most likely to be successful. ➔ They also helped to find 'champions' who later acted as multipliers in the project.	✓ Organise tenants to focus group meetings during the preparatory stage of the project. Also invite the staff who is going to be involved in operating and communicating the services.
	S-28 Maintenance staff involvement in service design proved to be very useful for use case definition and subsequent roll-out.	➔ Caretakers and other maintenance staff contributed to specifics of buildings and systems installed. ➔ This helped improve the efficiency of certain functionalities and accuracy of use case definition.	✓ When designing the architecture at the given estate, involve maintenance staff (e.g. via focus group meetings). Ask staff which action they would take and explain early on what the system will be able to do.
	S-29 Collaboration between partners involved in technical implementation is markedly better when use cases were agreed upon beforehand, using a common, and fully adequate description format.	➔ Agreement upon use cases reduced the number of technical difficulties and helped to add further innovation	✓ Web-service provider should design (simplified) UML use cases of all relevant functionalities for tenants, staff and automated systems. ✓ In a technical meeting agree which use cases are relevant and whether all steps can be handled by the parties involved.
	S-30 Designing one process model per use case helped to reduce the potential for misunderstandings.	➔ Having one process model per use case meant that all steps were always visible for all parties, as the result of which changes could be more easily agreed upon.	✓ For each use case, design one process model which covers all steps for all stakeholders. Within each step, decisions about design can remain in the hand of the developing / contributing party and do not need to be disclosed.
	S-31 Standardised use cases and process models helped reduce potential for misunderstandings.	➔ Staff with limited IT-knowledge benefited from conceptualised representations by which functionalities could be chosen from a "menu" and single steps be altered and deleted	✓ Provide a "menu" of all functionalities supported by your software and relevant for the pilot. First select the use cases to be installed (ideally a simplified UML); use as little technical jargon as possible.
	S-32 Since smart phones were not considered standard at the	➔ Some sites have yet no smart phone application since the focus was on web-services. Some web-	✓ Ensure the service can be extended to use other media by providing standardised data bases and open

Category	Issue	Impact	Recommendation
	beginning of the project, service was not designed to be accessed by these (now commonplace) end devices.	services are not optimised for smaller screens	data protocols as formats that are going to be used in future end devices cannot be anticipated. ✓ Investigate technical trends which are likely to have a direct bearing on the implementation.
	S-33 Service implementation benefits from public Wi-Fi infrastructure	➔ Where all tenants had free access to the internet through a public Wi-Fi, they were making more use of the energy portal. ➔ The EAS can be used as a means to attract tenants to develop their digital literacy skills.	✓ Explore possibilities for providing tenants with free internet access, e.g. through a public Wi-Fi infrastructure. ✓ One option can be to join together with other social housing companies and lobby local government for set-up of a public Wi-Fi network.

5.5.2 IT / Measurement Providers

Category	Issue	Impact	Recommendation
Technical set-up	**I-M-10** Tenant involvement during service design proved to be vital for the success of implementation.	➔ Focus group meetings with tenants helped to identify which service features are most likely to be successful. ➔ They also helped to find 'champions' who later acted as multipliers in the project.	✓ Organise tenants to focus group meetings during the preparatory stage of the project. Also invite the staff who are going to be involved in operating and communicating the services.
	I-M-11 Since smart phones were not considered standard at the beginning of the project, BECA services were not (in all cases) designed to be accessed by these (now commonplace) end devices.	➔ Some sites have yet no smart phone application since the focus was on web-services. Some web-services are not optimised for smaller screens	✓ Ensure the service can be extended to use other media by providing standardised data bases and open data protocols as formats that are going to be used in future end devices cannot be anticipated. ✓ Investigate technical trends which are likely to have a direct bearing on the implementation.
	I-M-12 Implementation benefits from public Wi-Fi infrastructure	➔ Where all tenants had free access to the internet through a public Wi-Fi, they were making more use of the energy portal. ➔ Service can be used as a means to attract tenants to develop their digital literacy skills.	✓ Explore possibilities for providing tenants with free internet access, e.g. through a public Wi-Fi infrastructure. ✓ One option can be to join together with other social housing companies and lobby local government for set-up of a public Wi-Fi network.
	I-M-13 Providing users with	➔ Frequent display of up-to-date energy	✓ Implement support of smart TVs (for instance, how

Category	Issue	Impact	Recommendation
	service via digital TV brought a number of advantages, including frequent display of energy related data to users and high acceptance among users.	consumption data to users through their TV set: Once every day the smart box would reset the channel and open dashboard when the TV is turned on. ➔ Positive response from users in spite of pro-active communication of consumption data.	to install set-top boxes); design a one-page dashboard optimised for large screens. ✓ Include information of daily interest – such as local temperature or traffic information – to keep users from switching channels before they can take in the information. ✓ Set dashboard to a simple channel (e.g. 88) which cannot be changed; this will make it easier to refer to the service for promotional purposes.
	I-M-14 Equipment across dwellings and its documentation is not necessarily up-to-date	➔ In case the issue is not discovered / resolved on time, delays in any of the project tasks may be caused. ➔ Project performance might be at risk	✓ Carefully check the documentation validity before you start implementing the service. ✓ Consult with building professionals for resource distribution systems within the buildings
	I-M-15 Many M-BUS gateways do not allow for reading measurements programmatically via a documented API, but only via a fixed-purpose software	➔ Selecting equipment requires effort ➔ It is hard to pair devices and protocols because of the lack of industrial approved standards. ➔ Implementation of systems requires additional verification.	✓ Set a clear list of requirements against which equipment is tested ✓ Test selected equipment on smaller scale ✓ Lobby on European level for suitable and robust protocol as a standard.
	I-M-16 Retrofitting measures: Specification of equipment	➔ Economic savings are achieved if appropriate equipment for each site is defined before starting the retrofitting project ➔ Resource savings achieved if, for instance, batters changes can be avoided	✓ Check which measures are to be taken during retrofitting ✓ Cross check the impact of a software technology and the hardware retrofitting impact. The latter can be reduced if a good ICT tool is efficiently implemented

5.5.3 Energy providers

Category	Issue	Impact	Recommendation
Technical set-up	**E-9** Tenant involvement during service design proved to be vital for the success of implementation.	➔ Focus group meetings with tenants helped to identify which service features are most likely to be successful. ➔ They also helped to find 'champions' who later acted as multipliers in the project.	✓ Organise tenants to focus group meetings during the preparatory stage of the project. Also invite the staff who are going to be involved in operating and communicating the services.

Category	Issue	Impact	Recommendation
	E-10 Maintenance staff involvement in service design proved to be very useful for use case definition and subsequent roll-out.	➔ Caretakers and other maintenance staff contributed to specifics of buildings and systems installed. ➔ This helped improve the efficiency of certain functionalities and accuracy of use case definition.	✓ When designing the architecture at the given estate, involve maintenance staff (e.g. via focus group meetings). Ask staff which action they would take and explain early on what the system will be able to do.
	E-11 BECA implementation benefits from public Wi-Fi infrastructure	➔ Where all tenants had free access to the internet through a public Wi-Fi, they were making more use of the BECA energy portal. ➔ The EAS can be used as a means to attract tenants to develop their digital literacy skills.	✓ Explore possibilities for providing tenants with free internet access, e.g. through a public Wi-Fi infrastructure. ✓ One option can be to join together with other social housing companies and lobby local government for set-up of a public Wi-Fi network.

5.5.4 City administration / social service providers

Category	Issue	Impact	Recommendation
Technical set-up	**C-6** BECA implementation benefits from public Wi-Fi infrastructure	➔ Where all tenants had free access to the internet through a public Wi-Fi, they were making more use of the BECA energy portal. ➔ The EAS can be used as a means to attract tenants to develop their digital literacy skills.	✓ Explore possibilities for providing tenants in public housing with free internet access, e.g. through a public Wi-Fi infrastructure. ✓ Check whether financial support can be obtained from the business sector.

5.5.5 Tenants

Category	Issue	Impact	Recommendation
Technical set-up	**T-11** Providing tenants with BECA services via digital TV brought a number of advantages, including frequent display of energy related data to users and high acceptance among users.	➔ Frequent display of up-to-date energy consumption data to users through their TV set: Once every day the smart box would reset the channel and open the BECA dashboard when the TV is turned on. ➔ Positive response from users in spite of pro-active communication of consumption data.	✓ Request that the feedback on consumption behaviour is being provided in ways which make best use of existing infrastructure, e.g. end devices (TV sets, smart phones), rather than adding new devices to the dwelling. ✓ Make sure that you know what to do in case of end devices or other technology not working properly.

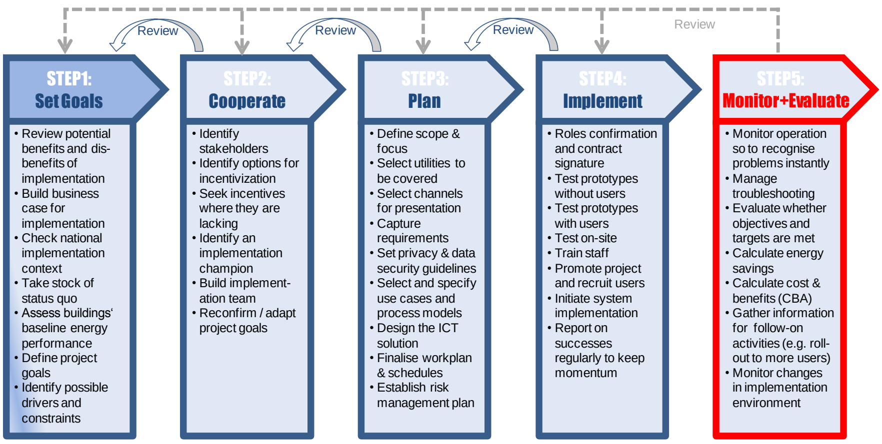
	T-12 Paper based manual for and technical support via phone.	➔ Users are not willing / able to read a lot of information ➔ Technical support via phone helped to provide users with necessary information.	✓ Besides the paper based manual, also provide technical support by phone. ✓ Set up a centralised hotline across various departments

6 Monitor & evaluate

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

Section	Title	Social Housing	City Council	IT-provider	Measurement	Energy provider	Social Services	Tenants	Policy Maker
7	***Monitor & evaluate***								
7.1	Monitoring and troubleshooting								
7.2	Evaluation of impacts on energy efficiency and GHG emissions								
7.3	Business case modelling and cost-benefit analysis								
7.4	The future								
7.5	Lessons learned & Recommendations								

Once BECA services are up-and-running, the main challenge is to monitor day-to-day operation in ways which allow you to recognise any emerging issues immediately in order to tackle them as swiftly and efficiently as possible. Troubleshooting is discussed in the following section (6.1).



Monitoring should not be limited to checking whether the technical system operates as expected; it should also cover non-technical issues such as changes in user satisfaction or in perceptions of risks. The latter can be affected strongly by reports in the local press or a shift in the public debate at national level, for example about the relationship between size and type of investments in energy efficiency and prevention of unmanageable climate change.

From the viewpoint of the housing providers, utilities and other market players involved, the most important element of the assessment of impacts relates to the **relation between costs and benefits**, as these decide about the **business case** for a roll-out of BECA services. The challenge here is to assign a monetary value to some of the softer, non-pecuniary variables.

We therefore make a distinction here between, on the one hand, evaluation of impacts on energy efficiency, GHG emissions, user perceptions and behaviours (section 6.2) and, on the other hand, business case modelling and cost-benefit analysis (section 6.3). Finally, in section 6.4 we will have a look at some of the most important trends that are likely to affect the market for smart-metering based energy efficiency and demand response services in the foreseeable future.

6.1 Monitoring and troubleshooting

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

At any time during service operation, problems can occur, be it with tenants, data delivery and quality or system maintenance. To prevent tenants from losing interest in the BECA services implemented, the implementation team should maintain close contact to tenants and professional users. A pro-active approach to addressing emerging problems is highly recommended.

The list below lists some scenarios from BECA pilot sites. This list is not exhaustive and should be freely extended, providing the relevant information: What problems can possibly occur, who is responsible for fixing it, what the options for mitigating actions are, and how the general implementation plan should be adapted to take account of the lessons learnt from the problem that has been faced.

Checklist 12: Troubleshooting

No	Problem type	Problem fixer	Options for mitigating action	Implications for implementation plan
1	Tenant has doubts about web portal functionality			
2	Tenant has questions about his energy bill			
3	Tenant detects irregular or missing data in the portal			
4	Tenant detects a problem with the web application			
5	Tenant has not received monthly report			
6	Energy manager detects missing data			
7	Energy manager detects problem with the web application			
8	Energy manager wants to communicate with tenant			
9	Energy manager detects building energy system problem			
10	Utility bill shows different cost figures than what is shown in the BECA service			

6.2 Evaluation of impacts on energy efficiency and GHG emissions

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

Tracking results of initiatives for implementation of smart metering is a powerful tool to underscore their efficacy and promote public awareness. Tracked results can also be used as a rationale for obtaining additional funding or for gaining public support for a broader portfolio of programs.

The methodology for conducting measurement of the system's impact on energy efficiency consists of the following components:

- Definition of ratios, terms and options;
- Presentation of relevant general methodologies;
- Calculations of energy savings based on pre-post comparisons including the definition of baseline and reporting period, the methods for (temperature) adjustments and the consideration of different situations;
- Definition of a control-group design as additional or alternative source of estimation;
- Alternative options of savings calculations if neither pre-post comparisons nor control groups are appropriate;
- Determination of further relevant parameters (persistence, statistical data analysis);
- Methodology for demand response estimation (peak demand reduction);
- Methodology for the estimation of avoided CO_2 emissions.

It is recommended to make use of internationally accepted standards for evaluation of an intervention's impacts on energy consumption. The International Performance Measurement and Verification Protocol (IPMVP) appears to be most suitable for the purpose at hand, see box below.

International Performance Measurement and Verification Protocol (IPMVP)[49]

IPMVP specifies that energy consumption of buildings should be measured with calibrated metering systems. Each energy type needs its own metering system, which should be independent from each other (see measurement boundaries, IPMVP, vol. 1, p14). The IPMVP measurement and verification plan (M&V Plan) provides a framework containing basic methods that are important for evaluation planning. A complete M&V Plan includes the following 13 topics (IPMVP, vol. 1, p39 ff.):

- Intent of energy conservation measures (ECM): Description of the planned services, conditions and intended results
- Selection of option and measurement boundary: IPMVP differentiates between four options to specify determinations of savings (IPMVP, vol. 1, p21f and fig. 3 on page 37)
- Definition of baseline: Period, energy data and conditions (independent variables such as outdoor temperature; static factors such as building characteristics or equipment inventory)
- Definition of reporting period: Period after intervention, e.g. installation of EAS or EMS
- Definition of basis for adjustment: Description of a set of conditions to which all energy measurements will be adjusted (e.g. temperature adjustments)
- Specification of analysis procedure: Used statistical data analysis procedures
- Specification of energy prices: Prices that will be used to value the savings (of importance in cases of adjustment needs because of prices changes)
- Meter specifications: Description of metering points and periods (of importance in cases of not continuous energy consumption metering)
- Assignment of monitoring responsibilities: Definition of responsibilities for recording and reporting of energy data

• Evaluation of expected accuracy: Statistical accuracy of the measurement

• Definition of budget required for savings determination: Initial set-up costs and ongoing costs throughout the reporting period

• Specification of report format: Description of how result will be reported and documented

• Specification of quality assurance: Description of quality assurance procedures

The M&V Plan mainly focuses on meter installation, calibration and maintenance; data gathering and screening; development of computation methods and – if necessary – acceptable estimations; computation of measured data and reporting, quality assurance and third-party-verification of reports.

PMVP provides four options for determining savings:

Option (A) **Retrofit Isolation – Key Parameter Measurement**: Savings are determined by field measurement of the key performance parameter(s) which define the energy use of the energy conservation measure's (ECM) affected system(s) and/or the success of the project. Parameters not selected for field measurement are estimated. Estimates can be based on historical data, manufacturer's specifications, or engineering judgment. Documentation of the source or justification of the estimated parameter is required. Typical applications include a lighting retrofit, where the power drawn can be monitored and hours of operation can be estimated.

Option (B) Retrofit **Isolation – All Parameter Measurement**: Savings are determined by field measurement of all key performance parameters which define the energy use of the ECM-affected system. Typical applications include a lighting retrofit where both power drawn and hours of operation are recorded.

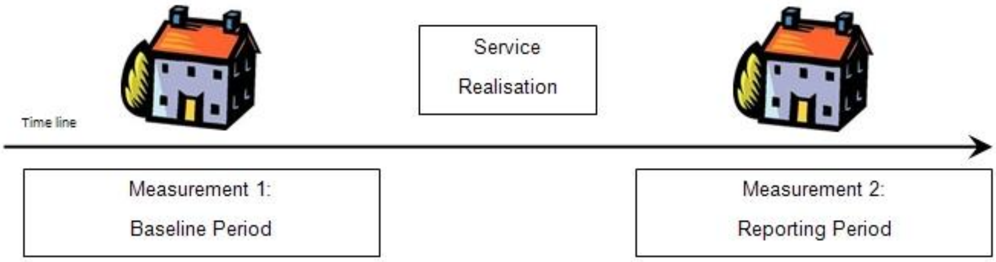
Option (C) **Whole Facility: Savings** are determined by measuring energy use at the whole facility or sub-facility level. This approach is likely to require a regression analysis or similar to account for independent variables such as outdoor air temperature, for example. Typical examples include measurement of a facility where several ECMs have been implemented, or where the ECM is expected to affect all equipment in a facility.

Option (D) **Calibrated Simulation**: Savings are determined through simulation of the energy use of the whole facility, or of a sub-facility. Simulation routines are demonstrated to adequately model actual energy performance measured in the facility. This Option usually requires considerable skill in calibrated simulation. Typical applications include measurement of a facility where several ECMs have been implemented, but no historical energy data is available.

For application in BECA implementation projects, option C is most suitable. It basically means a before-after comparison (i.e. before and after an intervention, e.g. the implementation of smart metering based consumption feedback solution) using prior consumption for an estimation of "non-intervention consumption". An additional or alternative source of estimation is a control building approach – in particular if no baseline energy consumption data are available as the system has been installed in a newly erected building.

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

Exhibit 20: Before-after-analysis for one building

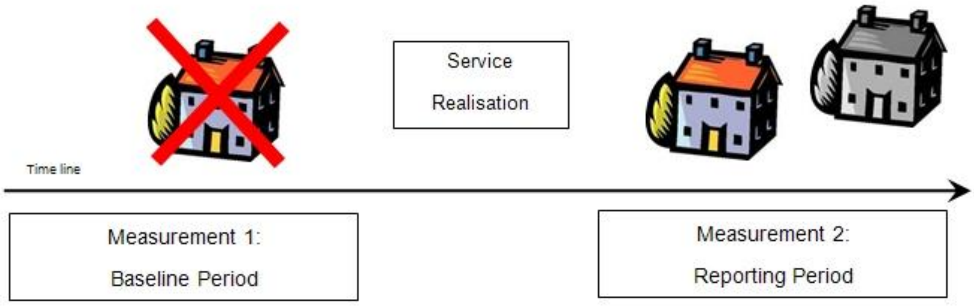


To ensure the conclusion that energy savings are caused by the BECA system installed (EAS or EMS), all other conditions influencing energy consumption have to be identical in both baseline and reporting period (*ceteris paribus*). Furthermore the measurement of data itself has to be the same or has to be on a comparable basis in both periods.

In practice, this means that comparisons of e.g. heating energy consumption between two or more heating periods (e.g. pre-post-comparisons) require an adjustment which accounts for the fact that climate conditions are bound to differ between both periods. This is called temperature adjustment. Different methods for this are in use. The methodology most widely used in Europe is the Heating Degree Day (HDD) Calculation Model. Heating degree days are typical indicators of household energy consumption for space heating. The air temperature in a building is on average 2°C to 3°C higher than that of the air outside. A temperature of 18°C indoors corresponds to an outside temperature of about 15.5° C. If the air temperature outside is 1°C below 15.5°C, then heating is required to maintain a temperature of about 18°C. If the outside temperature is 1°C below the average temperature it is accounted as 1 degree-day. The sum of the degree days over periods such as a month or an entire heating season is used in calculating the amount of heating required for a building. Degree Days are also used to estimate air conditioning usage during the warm season. Instructions how to apply the model are available from IPMVP.

If no adequate baseline energy consumption data are available – for example in case of new constructions or due to different measurement methods/technologies – a control building methodology allows obtaining comparable energy consumption data. A control building is a similar building which roughly matches the characteristics of the building to be evaluated (e.g. kind of building, location, equipment, insulation, heating system, relation of public and private areas). The control building should also more or less match the building to be evaluated in terms of socio-demographic characteristics of tenants. In the best of cases the only difference between both experimental and control building is the availability / absence of an intervention, i.e. introduction of EAS (*ceteris paribus* conditions). The advantage of a control building design is – as its name implies – that the impact of an intervention can be controlled for other influencing effects, and that no temperature adjustment is required if data is collected for the same reporting period.

Exhibit 21: Control building design



6.3 Business case modelling and cost-benefit analysis

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

A business case modelling approach is recommended as an analytic process following the different stages of the deployment cycle employed for service development. The main purpose of the business case modelling exercise is to inform service development as far as requirements from the business side are concerned and to ensure that these requirements are met to the greatest possible extent. This includes the analysis of service costs and benefits of different actors, the due consideration of financing means and the re-modelling of the service concept to ensure economic viability.

In methodological regard the approach is build around a cost-benefit analysis (CBA), which was chosen over alternative approaches (such as cost-effectiveness analysis and cost-utility analysis) because it allows to adopt a multi-stakeholder perspective, i.e. costs and benefits can be analysed separately for different actors. This is of particular advantage in the fragmented environment for energy efficiency measures, where many different actors (tenants, social housing companies, measurement and service providers, the IT industry and others) are involved, whose costs and benefits need to be balanced individually to achieve a viable and sustainable service model.

For business case modelling, the key stakeholders of the BECA implementation project need to analyse their new services with a view on different types of costs and benefits, differentiated between each stakeholder party. For this purpose it will be necessary to organise meetings involving relevant representatives of all key partner organisations. The meetings should consist of a guided discussion in four steps as follows:

- Step 1. Definition of the main cost recovery mechanism: how cost for the service (both investment cost related to *implementation* and running cost related to its continuous *operation*) will be recovered.
- Step 2. Refinement of the initial cost/benefit model: what are the costs and benefits for each stakeholders and the cost/benefit exchange relations between stakeholders.

- Step 3: Operationalisation of cost and benefit indicators: what data are needed to include a given cost or benefit item into the analysis and how these data will be collected.
- Step 4: Collection of the data for all defined indicators as well as of baseline data such as staff wages. Data are collected either from the evaluation or directly from relevant sources at the site, such as log-files containing data of the technical system.

A full-scale cost-benefit-tool capable of modelling ICT-based energy efficiency solution and its documentation can be obtained upon request (BECA@empirica.com).

6.4 The future

Social Housing	City Council	IT provider	Measure provider	Energy provider	Social Services	Tenants	Policy Maker

Reading relevance scale: Darker colour equals higher chapter relevance for the specified target group.

Implementation of smart meter based services in the residential sector in general, and in the social housing sector in particular, is still in its infancy. The regulation landscape is still very much in development, and technical solutions have only very recently entered a stage of maturity. What is more, making assumptions about the whole energy sector is made difficult by the fact that nobody can say for sure what the future will bring: Will we see exploding energy prices or at least wild fluctuations in market rates? Will the climate crisis exacerbate, leading to radical measures for drastic reductions of energy consumption?

Against this background, any decision about investments in energy efficiency is fraught with uncertainty. Nevertheless, we can observe some trends which are very likely to continue in the foreseeable future to affect the social housing market across all of Europe.

On the part of consumers (end-users) there are clear indications of:

- Growing demand for smart metering technologies because energy prices are expected to rise further.
- Increases in the share of households at risk of fuel poverty, which will lead to demands for further assistance in terms of help in reducing utility bills.
- Further spread of devices through which services based on smart metering can be provided in a more user-friendly way; this refers in particular to increasing rates of smart phone ownership, which is gradually reducing the cost of providing personalised information to customers, and the effort it takes to use them.
- A general shift in the focus of initiatives “from traditional consumer information to consumer empowerment”[50].

Trends regarding government response are the following:

- Increasing pressure to agree on binding energy saving targets which will go much beyond the 2020 targets. It will only be possible to meet these goals if the housing sector’s performance improves considerably, making it likely that governments will intervene in the sector more directly in the coming years.
- Consumption based billing for all energy types is to become the norm across all of Europe – also in those countries where it is the exception so far.

- As a carrot for housing providers, it is to be expected that certain appliances and types of investments will receive generous subsidies – but there remains a lot of uncertainty in this area.
- Data protection regulation will to become clearer with respect to the use of smart metering technologies; this also includes questions of data ownership in online provider-customer relationships. For example, in the course of 2013 the Smart Grids Task Force, established by the European Commission to issue regulatory recommendations for data safety, data handling and data protection, will publish a data protection impact assessment template and a benchmarking report on the roll-out of Smart Metering in the EU. [51]
- Trends in business response are as follows:
- Because of the limited extent to which private households can be attracted to respond to smart metering provided information, business will increasingly target innovative services to housing organisations, utilities and energy service companies (ESCOs) offering energy performance contracting.
- Smart metering systems are, however, becoming more user-friendly, inspiring, ambient, sometimes providing more impressionist and less numerical and graphical feedback. Devices and applications are typically more aesthetic, ergonomic and intuitive, therefore relying less on fat manuals and consumer technical-learning time. This could lead to devices and applications that customers will desire rather than endure.[52]
- Another trend is that technologies are converging, integrating more elements of feedback and control within one solution and overcoming more and more inter-connectivity issues, allowing an enhanced extended plug and play experience for the consumer, and an improved commercial business case for utilities or other parties offering the service which is based upon the technology. [53]
- Smart meter standardization is expected to make tangible progress in the coming years. As a result the market for innovative services based on standards and open protocols is expected to expand swiftly, leading to a much improved offer of services;
- There are trends that work as deterring factors as well. At times of increasing underlying price levels for energy, it can be difficult for utilities to introduce energy efficiency and demand response programmes: In such a situation, energy savings can easily be overcompensated by rising prices, making consumers think that the new technology is the reason for their larger bill.[54]
- This last point reminds us again of the key importance of consumer engagement and information, enabled by technology but making full use of traditional methods of interaction such as participation in planning, focus groups meetings, campaigns for awareness raising and education, as well as use of energy coaches which provide hands-on support to tenants, which are at the heart of a successful program for implementation of smart meter enabled energy efficiency and demand response services.

6.5 Lessons learnt & Recommendations

Lessons are grouped by stakeholder for whom the step is relevant.

6.5.1 Social Housing providers

Category	Issue	Impact	Recommendation
Outcomes	**S-34** Implementation of management systems lead immediately to the detection of major problems affecting energy efficiency of the building stock.	➔ Considerable savings in energy. ➔ Enthusiastic response from building / energy managers. ➔ Investments in EMS paid off over a short period of time.	✓ Use EMS to obtain immediate, sustained savings by detecting and abolishing malfunctioning systems and sources of energy loss.
	S-35 Monitoring heat production proved to be essential for reduction of energy consumption.	➔ Management services (EMS) monitoring heat production sites (especially centralised systems) helped detect defaults sooner ➔ This enabled the swift elimination of inefficiencies and wastage.	✓ Install management systems first to ensure catching the "easy wins" and herewith collecting funds for further installations. ✓ Consider automated alarms. ✓ Train staff properly to use the EMS for detection of problems. Include training measures in the budget for EMS implementation.
	S-36 Effects of using management system was better if access to the system was given to maintenance staff as well.	➔ Offering other technical and maintenance staff access to the EMS lead to detection of defaults in the existing infrastructure which had caused inefficiencies.	✓ Provide (restricted) accounts to all staff and suggest any checks they could do remotely rather than in person. This enables better monitoring of more buildings at the same time.
	S-37 Practical hints on how to reduce energy use lead directly to changes in tenant behaviour.	➔ Clear evidence of changes in behaviour caused by practical advice given, resulting in lower energy consumption and utility bills	✓ The more practical and easily applicable recommendations to tenants are, the easier it will be for users to modify their behaviour. ✓ Make smart use of the online tenant interface to provide energy advice (in bite-sized formats) to tenants.
	S-38 ICT monitoring identified issues with Solar Thermal System	➔ Due to the temperature settings of the centralised system, the fraction which ST provided energy was detected to be lower than expected. ➔ After an adjustment of these settings, an important increase of the ST provided energy was achieved.	✓ Implement a monitoring system for renewables. ✓ Integrate alerts into ICT-solution ✓ Check the impact(s) of any new implemented settings, easier and cheaper with EMS.

Category	Issue	Impact	Recommendation
	S-39 Communication campaigns benefit from the use of evidence collected at the same site.	➔ Tenants at various sites welcomed BECA implementation especially because of its ability to provide immediate, quantitative evidence of the results of energy saving measures. ➔ Communication of aggregate savings, e.g. across the entire building stock, appeared to work well in promotional efforts.	✓ Any communication campaign recommending methods to reduce energy consumption should also provide means by which the success of the citizen's effort can be measured. ✓ Make evaluation a core part of the implementation work plan. Make sure that evidence of energy savings is gathered as soon after the project start as possible, and use it for subsequent information and promotion activities.
	S-40 Internal resources / cost for billing can be saved / reduced.	➔ Service enabled housing provider to organise billing by themselves instead of contracting it to more expensive party. ➔ Time spent on complaint procedures could be cut as evidence for billing and on-going consumption was integrated while being accessible to tenants.	✓ Coordinate with financial department to ensure data created allows for billing procedures. ✓ Coach administrative stuff how to use service in order to quickly check upon evidence during calls. ✓ Make it easy for tenants to contact responsible at billing department by providing details for – ideally - personalised contact to close complaint case with first occurrence.
	S-41 In environments with, already, low consumption BECA is tool for detecting wastage, not additional savings.	➔ If saving the focus, user consider not needing the service and therefore do not benefit from other features. ➔ Wastages is only detected with next bill.	✓ Check whether consumption levels – given the local environment – are low or high. ✓ Adjust focus of materials and communication accordingly.

6.5.2 IT / Measurement Providers

Category	Issue	Impact	Recommendation
Outcomes	**I-M-17** Effects of using management system was better if access to the system was given to maintenance staff as well.	➔ Offering other technical and maintenance staff access to the EMS lead to detection of defaults in the existing infrastructure which had caused inefficiencies.	✓ Design the EMS to allow for limited access by different types of staff so that as many practitioners as possible can be involved in detecting problems and developing solutions concerning energy management of the building stock.
	I-M-18 Monitoring heat production proved to be essential for reduction of energy consumption.	➔ Management services monitoring heat production sites (especially centralised systems) helped detect defaults sooner	✓ Install management systems first to ensure catching the "easy wins" and herewith collecting funds for further installations.

Category	Issue	Impact	Recommendation
		➔ This enabled the swift elimination of inefficiencies and wastage.	✓ Consider automated alarms. ✓ Communicate to building manager that they need to train their staff properly to use the EMS for detection of problems. Include training measures in your calculation for budgeting EMS implementation.
	I-M-19 Practical hints on how to reduce energy use lead directly to changes in tenant behaviour.	➔ Clear evidence of changes in behaviour caused by practical advice given, resulting in lower energy consumption and utility bills	✓ The more practical and easily applicable recommendations to tenants are, the easier it will be for users to modify their behaviour. ✓ Design the online tenant interface in a way which facilitates effective provision of energy advice (in bite-sized formats) to tenants.
	I-M-20 Communication campaigns benefit from the use of evidence collected at the same site.	➔ Tenants at various sites welcomed BECA implementation especially because of its ability to provide immediate, quantitative evidence of the results of energy saving measures. ➔ Communication of aggregate savings, e.g. across the entire building stock, appeared to work well in promotional efforts.	✓ Design the service in a way which allows continuous collection of aggregate data on savings. ✓ Make sure that evidence of energy savings is gathered as soon after the project start as possible, and use it for subsequent information and promotion activities.
	I-M-21 A greater interaction of public utility companies with tenants is needed	➔ A higher involvement of public utility companies in relations with tenants would provide a better level of understanding between public utility companies and tenants ➔ Users' level of confidence with regard to the offered service will increase	✓ Involve public utility companies in every aspect that concerns them and their consumers.

6.5.3 Energy providers

Category	Issue	Impact	Recommendation
Outcomes	**E-12** Automated temperature settings lead to reduced wastage	➔ Limiting the provision temperature to a set temperature (e.g. 21°C) lead to savings in energy consumption since tenants were kept from regulating temperature by opening windows. ➔ The pilot experience does *not* indicate that	✓ Implement a feature which can set a maximum temperature up to which supply of heating is guaranteed. ✓ Make sure the system still allows for supplying (selected) users with the option to regulate the

Category	Issue	Impact	Recommendation
		acceptance by tenants will be a serious problem.	temperature through a home display or similar.
	E-13 EAS offers much enhanced possibilities for peak shaving	➔ Dwellings heated by electricity were used successfully to regulate predicted peaks by 'storing heat' and reducing heat production during peak times. ➔ Substantial peak-shaving realised.	✓ Estimate costs of peak times and contact housing companies to use estates as "virtual batteries". ✓ To offset any perceived loss of comfort due to peak-shaving, consider offering tenants some kind of compensation, e.g. vouchers or discounts.
	E-14 Monitoring heat production proved to be essential for reduction of energy consumption.	➔ Management services (EMS) monitoring heat production sites (especially centralised systems) helped detect defaults sooner ➔ This enabled the swift elimination of inefficiencies and wastage.	✓ Install management systems first to ensure catching the "easy wins" and herewith collecting funds for further installations. ✓ Consider automated alarms. ✓ Train staff properly to use the EMS for detection of problems. Include training measures in the budget for EMS implementation.
	E-15 Communication campaigns benefit from the use of evidence collected at the same site.	➔ Tenants at various sites welcomed BECA implementation especially because of its ability to provide immediate, quantitative evidence of the results of energy saving measures. ➔ Communication of aggregate savings, e.g. across the entire building stock, appeared to work well in promotional efforts.	✓ Any communication campaign recommending methods to reduce energy consumption should also provide means by which the success of the citizen's effort can be measured. ✓ Make evaluation a core part of the implementation work plan. Make sure that evidence of energy savings is gathered as soon after the project start as possible, and use it for subsequent information and promotion activities.
	E-16 Practical hints on how to reduce energy use lead directly to changes in tenant behaviour.	➔ Clear evidence of changes in behaviour caused by practical advice given, resulting in lower energy consumption and utility bills	✓ The more practical and easily applicable recommendations to tenants are, the easier it will be for users to modify their behaviour. ✓ Make smart use of the online tenant interface to provide energy advice (in bite-sized formats) to tenants.

6.5.4 City administration / social service providers

Category	Issue	Impact	Recommendation
Outcomes	**C-7** Where the city is directly responsible for paying the energy bills of social housing tenants, BECA offers a range of possibilities for achieving savings.	➔ Limiting the provision temperature to a set temperature (e.g. 21°C) lead to savings in energy consumption since tenants were kept from regulating temperature by opening windows. ➔ The pilot experience does *not* indicate that acceptance by tenants will be a serious problem.	✓ Press for piloting of practices which regulate energy consumption centrally, thereby leading to direct savings from lower energy bills.
	C-7 Service can be utilised to monitor temperatures across social housing stock using actual data instead of estimates	➔ This makes it easier to guarantee compliance with regulation concerning minimum temperatures to be supplied to tenants. ➔ Complaints by tenants can be addressed more effectively.	✓ Where compliance with regulation concerning minimum temperatures to be supplied to tenants is an issue, make sure that the BECA system to be implemented supports monitoring of actual room temperatures across all social housing building stock.
	C-8 Direct conversations with city council to replicate project measures in other public buildings.	➔ Help to expand the results of the project in other municipal buildings. ➔ Benefits replication of BECA solution to a wider environment	✓ Present achieved results to the municipal authorities. ✓ Plan financial funds as part of the annual budget for similar activities as the service might be attractive for being used in as part of the energy efficiency programs in the municipality.

6.5.5 Tenants

Category	Issue	Impact	Recommendation
Outcomes	**T-13** Automated temperature settings lead to reduced wastage.	➔ Limiting the provision temperature to a set temperature (e.g. 21°C) lead to savings in energy consumption since tenants were kept from regulating temperature by opening windows. ➔ The pilot experience does *not* indicate that acceptance by tenants will be a serious problem.	✓ If the maximum temperature in dwellings is regulated this way, make sure that the actual temperature delivered is as high as promised. ✓ Request that the system still allows for supplying (selected) users with the option to regulate the temperature through a home display or similar.
	T-14 EAS offers much enhanced possibilities for peak shaving.	➔ Dwellings heated by electricity were used successfully to regulate predicted peaks by reducing heat production during peak times.	✓ Tenants should benefit as well from the energy savings generated via peak shaving. Request some kind of compensation, e.g. vouchers or discounts.

		➔ Substantial peak-shaving realised.	
	T-15 Practical hints on how to reduce energy use lead directly to changes in tenant behaviour.	➔ Clear evidence of changes in behaviour caused by practical advice given, resulting in lower energy consumption and utility bills	✓ Request that advice is given in the form of practical and easily applicable recommendations. ✓ Request that smart use is being made of the online tenant interface to obtain energy advice, possibly also on-demand.
	T-16 Frequency of automated warning	➔ Receiving the same alert for several weeks will lead to considering any message as useless. ➔ Professionals, in particular, require being pointed real issues and heavy consumers.	✓ Implement procedure to avoid sending same alert over again (e.g. surpass or propose change via direct link) ✓ Messages and recommendations need to change frequently in order to capture attention and involve actions.

PART C:
ANNEX

'Part C: Annex' collects technical details, regulatory and legal developments and all checklists introduced in 'Part B: Guider for Replication'.

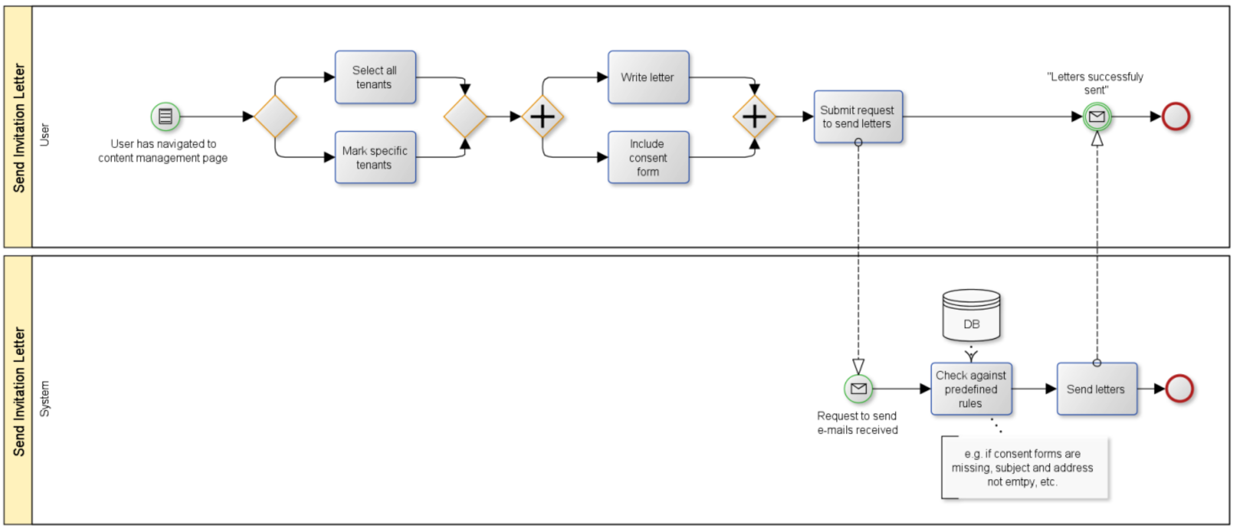
7 Use cases for EAS

In order to present the use cases in a form useful for development of the service architecture, they have been integrated into use case diagrams describing the possible actions for tenants and system administrators and the detail of services which they can receive from the system. The diagram incorporates the features from all of the pilot sites.

The functional use case descriptions in tabular form are followed by integrated diagrams.

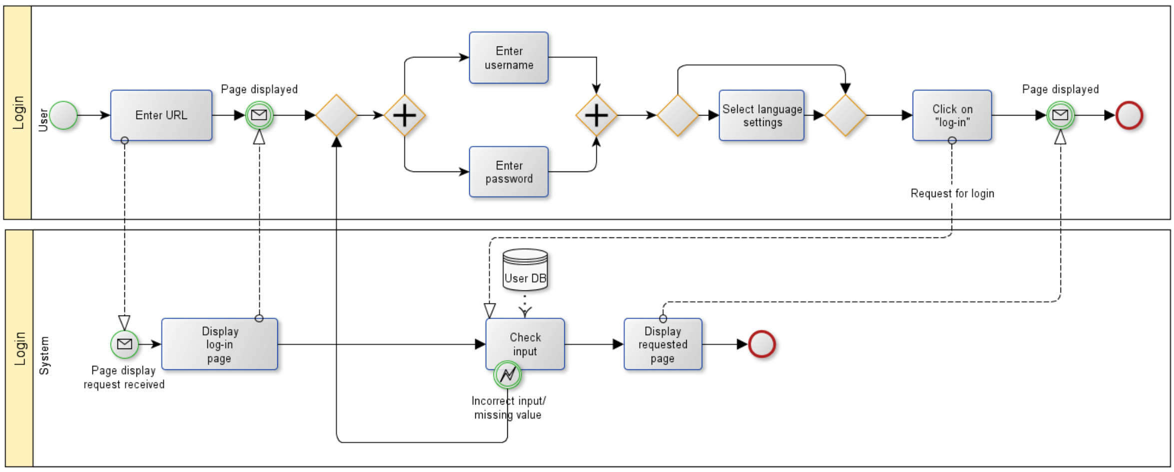
7.1 Send invitation letter

Name of the Use Case:	**UC1: Send Invitation Letter**
Summary	Housing provider sends a letter to the tenants to inform them about the new service.
Normal flow of activities	1. Identify tenants to be addressed 2. Write information letter including • project description • objectives of the project • motivate to participate in the project • explain why it is necessity to read consumption values (e.g. electricity, heating, gas) • point out that it is necessary to sign an acceptance letter if the tenant is willing to participate in the project • Include a return letter which indicates that the tenant wants to participate in the project. This return letter has to be signed by the tenant. • Invitation to attend the information session 3. Send letter to tenants.
Alternative Flow	Consent can be part of log-in process in web-portal
Trigger	1. Systems and functions to be implemented are identified by pilot site.
Precondition	1. Buildings/dwellings of interest identified
Postcondition	1. Tenants are well informed 2. Potential project partners identified 3. Tenants are informed about the project



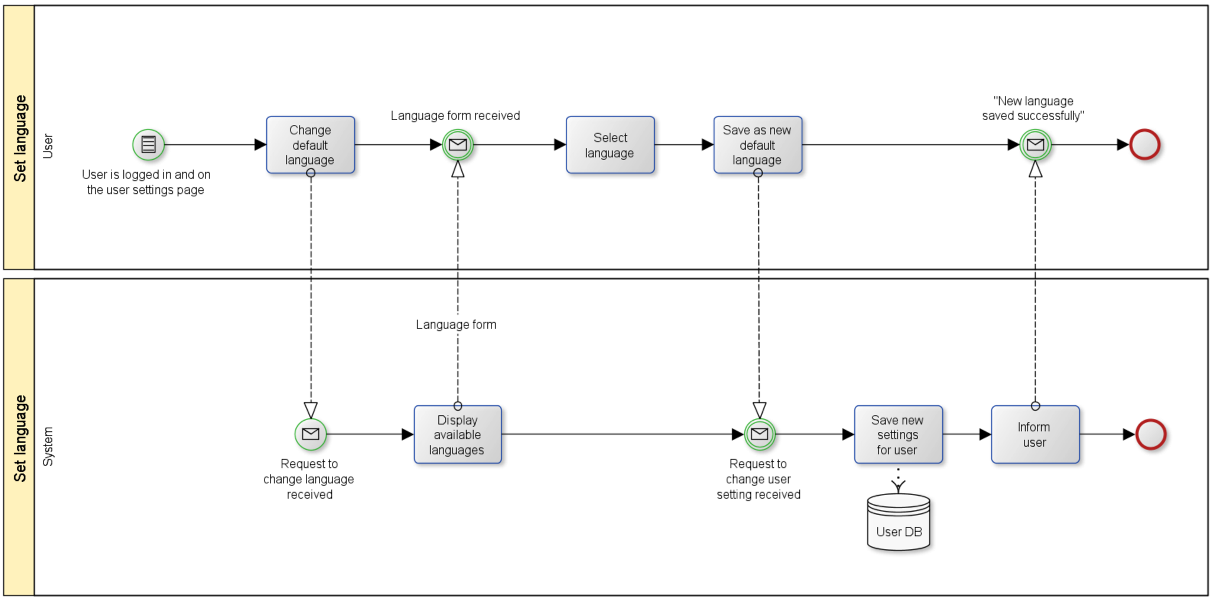
7.2 Login

Name of the Use Case:	**UC2: Login**
Summary	Login to the EAS web portal
Normal flow of activities	User enters Uniform Resource Locator (URL) web page. User provides user name and password, and optionally language settings. If the given credentials are valid (user is registered, user name and password are valid), the user is presented with the initial screen. Otherwise access to the web portal is refused.
Alternative Flow	If no language preference is provided, a default language is used.
Trigger	User wants to access the web portal.
Precondition	User has access to an internet-enabled terminal.
Postcondition	User is logged in and able to access services such as the viewing of consumption data, etc.



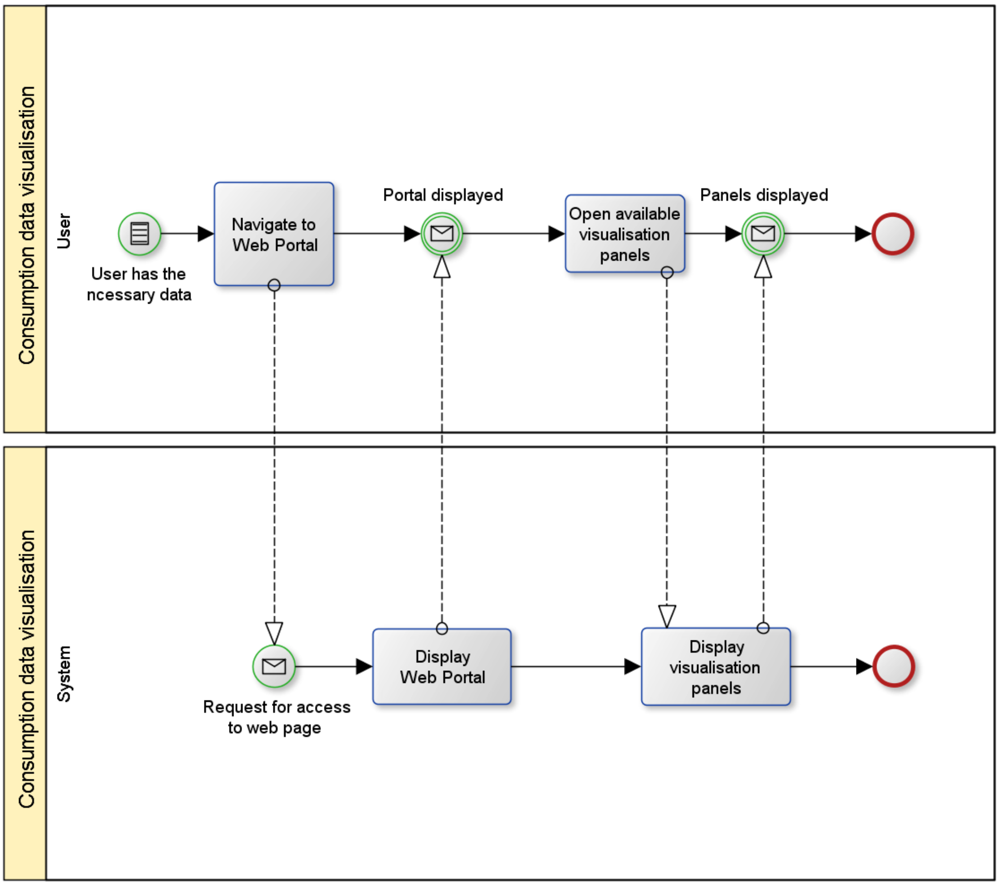
7.3 Set language

Name of the Use Case:	**UC3: Set language**
Summary	Language setting
Normal flow of activities	User chooses his preferred language
Alternative Flow	If no language preference is provided, a default language is used.
Trigger	User wants to change the language in which information is displayed.
Precondition	User is logged in.
Postcondition	User is able to access the service in his preferred language



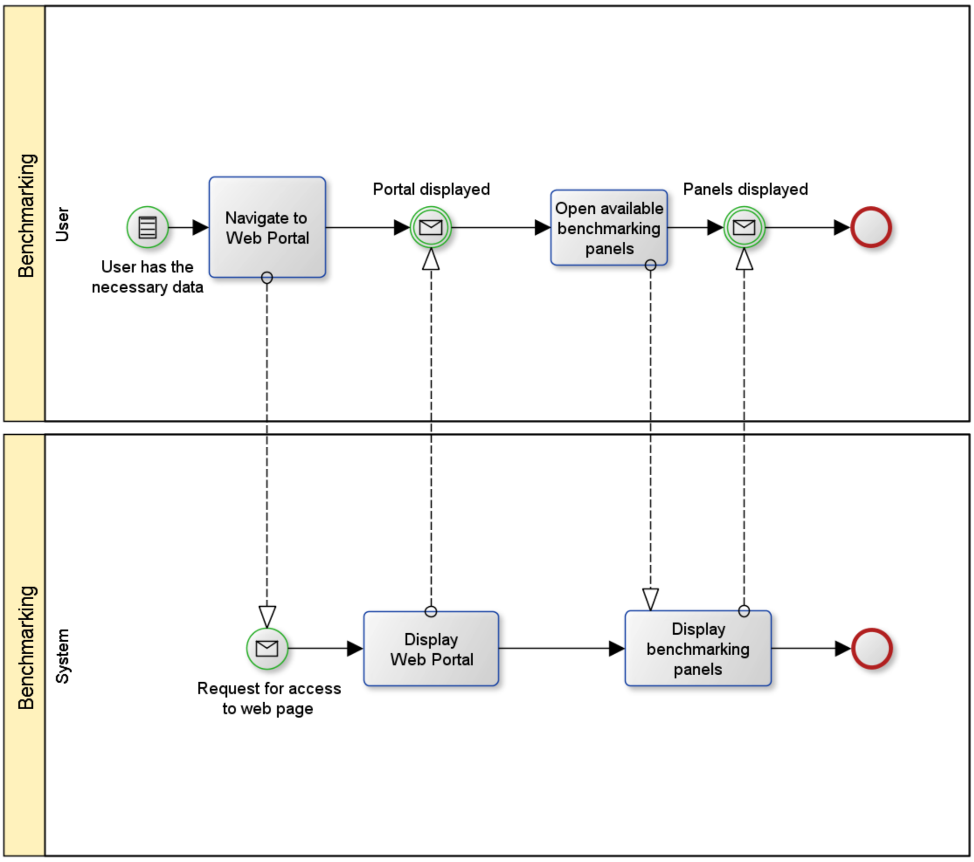
7.4 View Consumption Data

Name of the Use Case:	UC4: View Consumption Data
Summary	View energy consumption and other parameters
Normal flow of activities	User enters the web portal User opens the available visualisation panels in the application Tenant looks at energy consumption in kWh/m³, € or CO_2 for different periods (15 minutes, days, weeks, months, years). Tenant sees the link between the results by period and his energy consumption behaviour.
Alternative Flow	n.a
Trigger	User selects the *consumption data* page on the web portal
Precondition	Metering equipment has been installed and account configured. User is logged in.
Postcondition	User can now access the visualisation components of the EAS Tenants understand the influence of their behaviour on the consumption costs Tenants persuade others (e. g. relatives) to use the web portal



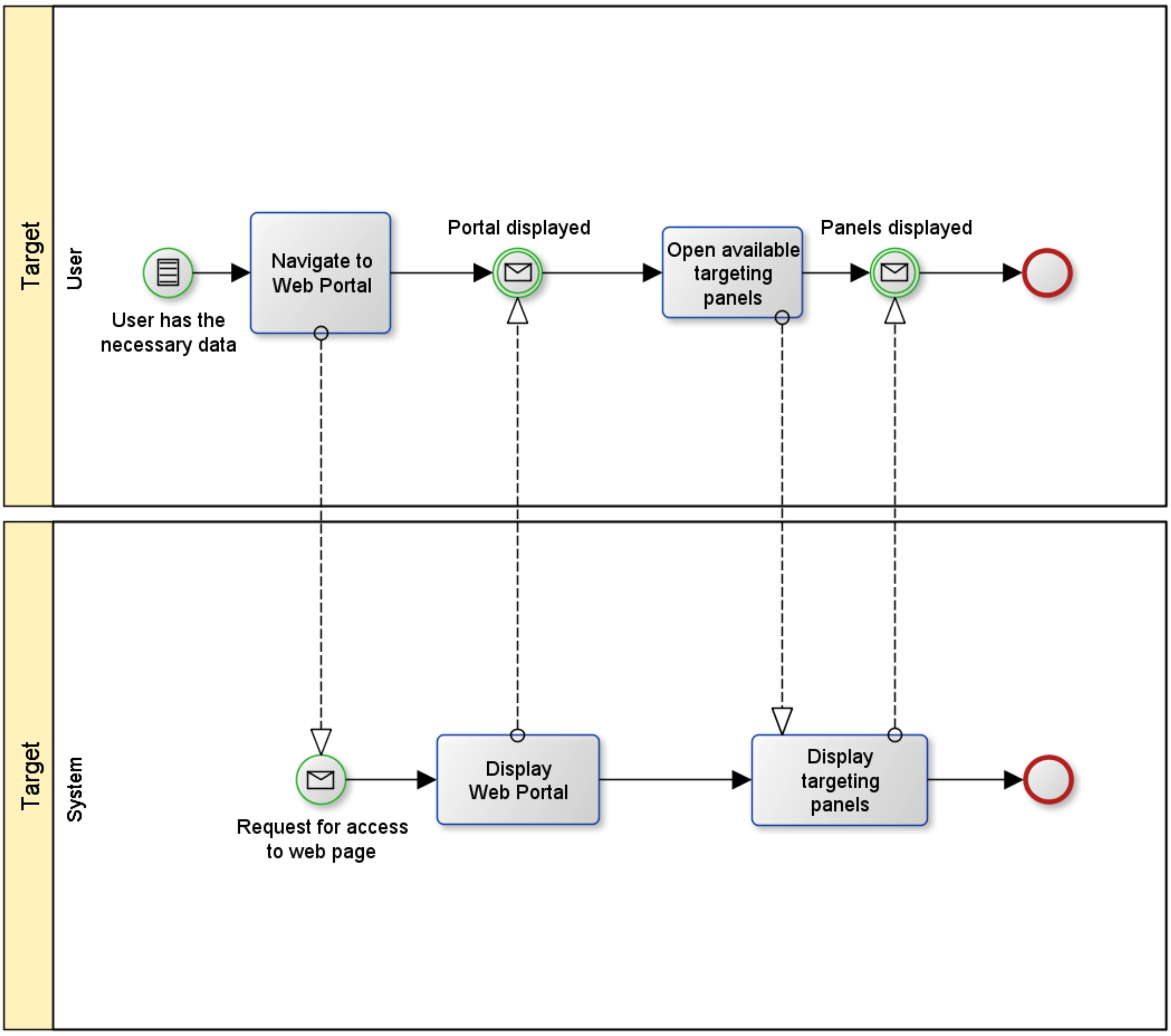
7.5 Benchmarking

Name of the Use Case:	**UC5: Benchmarking**
Summary	User can compare his consumption with reference values or with other established objectives.
Normal flow of activities	1. User enters the web portal 2. User opens the available benchmarking panels in the application 3. Tenant selects the type of benchmark, such as • previous periods • other/average tenants • similar household profiles 4. Tenant is presented with the selected benchmark.
Alternative Flow	n.a
Trigger	User selects the *benchmarking* page on the web portal
Precondition	Metering equipment has been installed and account configured. User is logged in.
Postcondition	Tenants understand the influence of their behaviour on consumption costs and can compare their own consumption with others.



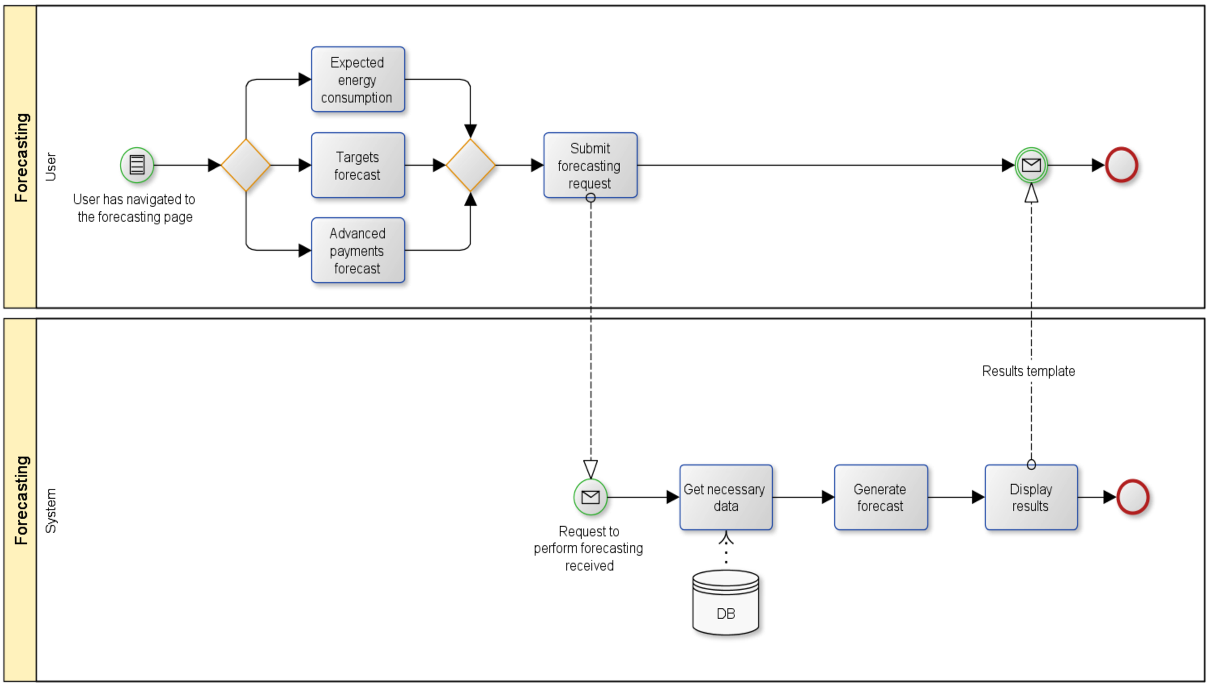
7.6 Target

Name of the Use Case:	**UC6: Target**
Summary	User can establish target or energy consumption objective for the month/year.
Normal flow of activities	User enters the web portal User opens the available targeting panels in the application User enters an objective for water and/or electricity.
Alternative Flow	n.a
Trigger	User decides to use a target for benchmarking and/or forecasting.
Precondition	Metering equipment has been installed and account configured. User is logged in.
Postcondition	Target is set and can be used in benchmarking and/or forecasting and/or alerts.



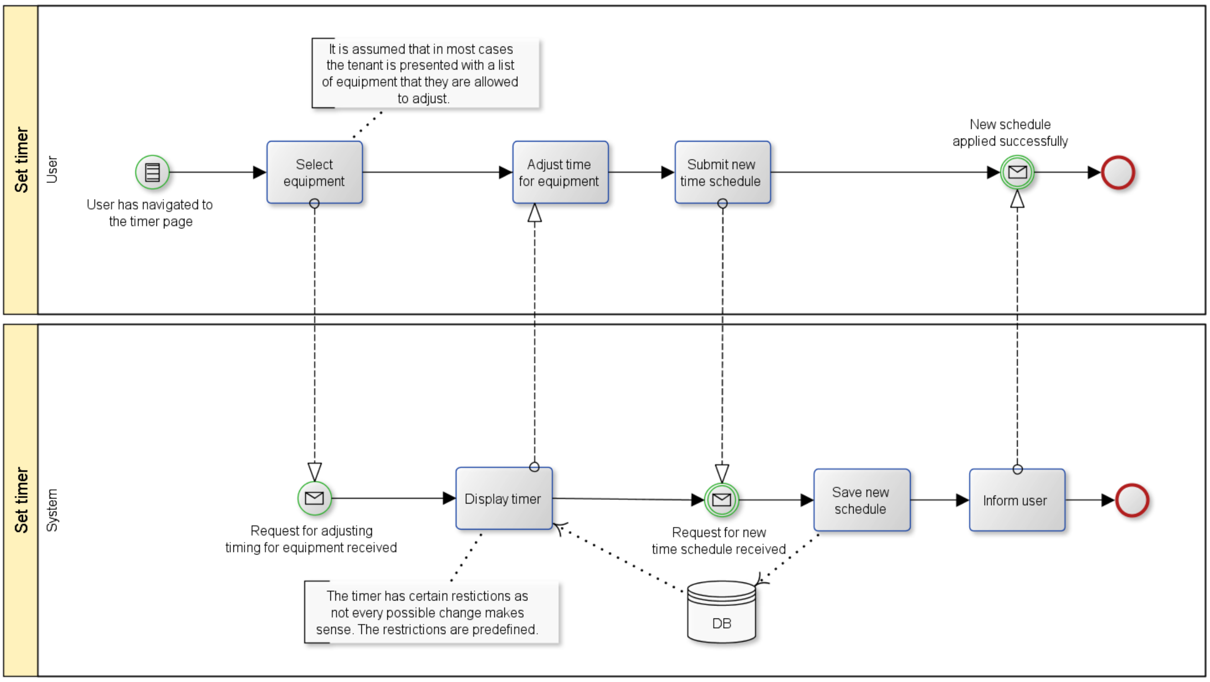
7.7 Forecasting

Name of the Use Case:	UC7: Forecasting
Summary	Analyse data of consumption to see whether advance payments or 'targets' will be reached or to get a forecast for the consumption until the end of the year.
Normal flow of activities	Tenant selects the forecast screen and depending on the type of forecast is presented with information about • what the expected energy consumption until the end of the year will be • whether previously established targets will be met, or • how long advance payments will last.
Alternative Flow	n.a.
Trigger	User selects the Forecasting page on the web portal.
Precondition	User is logged in.
Postcondition	Tenant knows the current forecast and is able to adjust his behaviour accordingly, if needed.



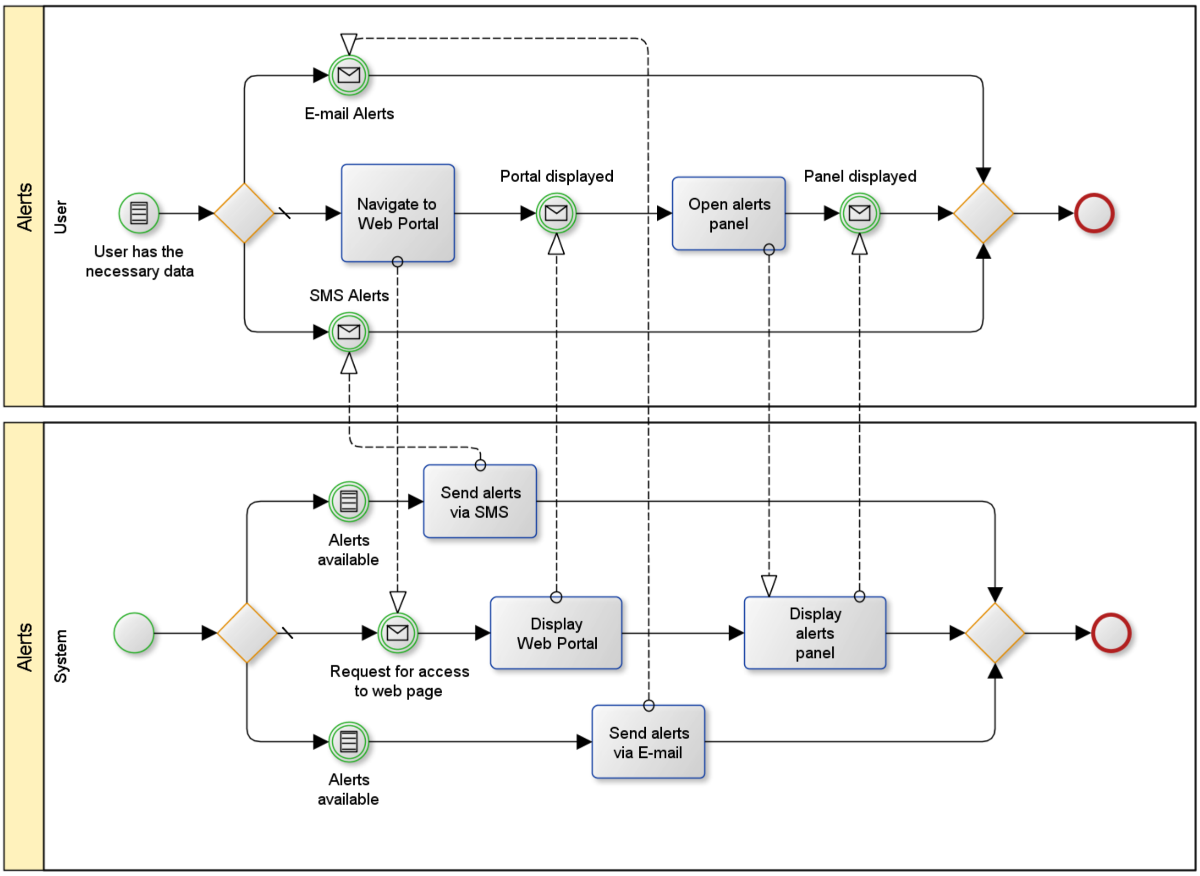
7.8 Set timer

Name of the Use Case:	**UC8: Set timer**
Summary	Tenant is able to programme equipment for certain periods of time.
Normal flow of activities	Tenant selects the *set timer* screen. Tenant enters heating times according to his needs.
Alternative Flow	n.a.
Trigger	User selects the timer page on the web portal.
Precondition	User is logged in.
Postcondition	Heating equipment is running according to the selected heating times.



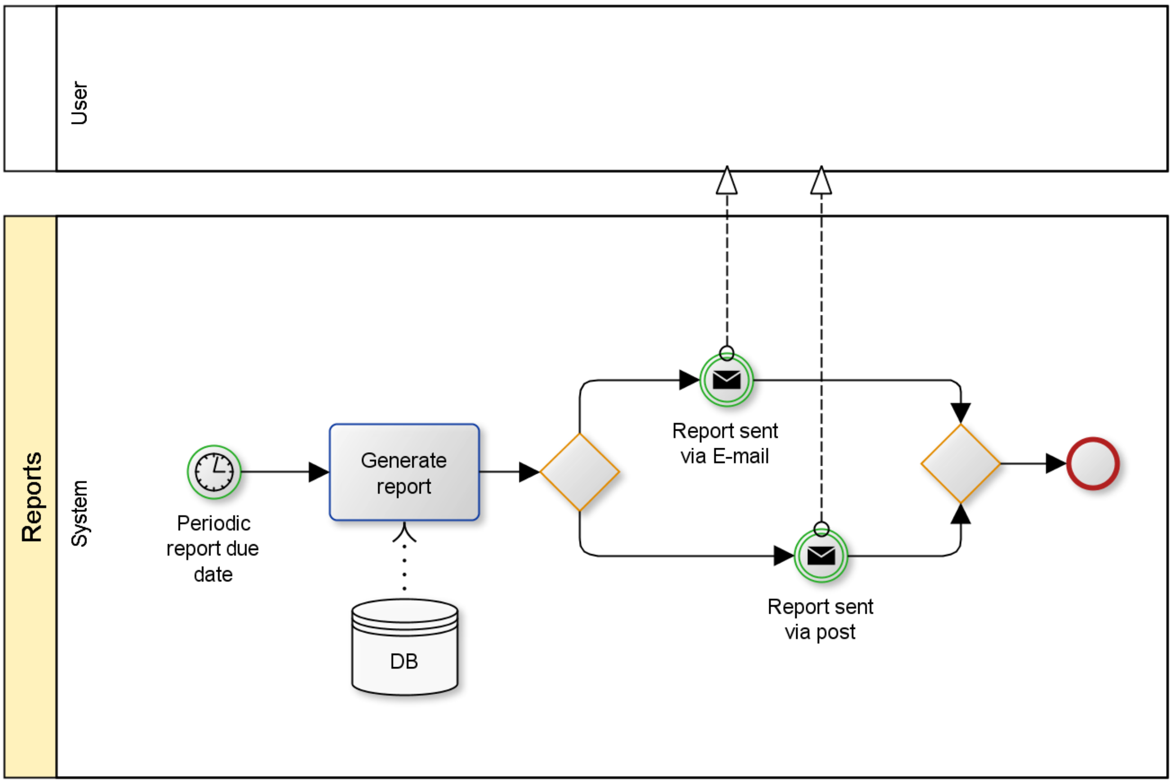
7.9 Alerts

Name of the Use Case:	**UC9: Alerts**
Summary	User can receive alerts when unusual consumption occurs or given limits are exceeded.
Normal flow of activities	User enters the web portal User opens the alerts panel of the application
Alternative Flow	User receives alerts by email User receives alerts by SMS
Trigger	User wants to receive alerts about his consumption
Precondition	Metering equipment has been installed and alerts are configured
Postcondition	User receives alerts



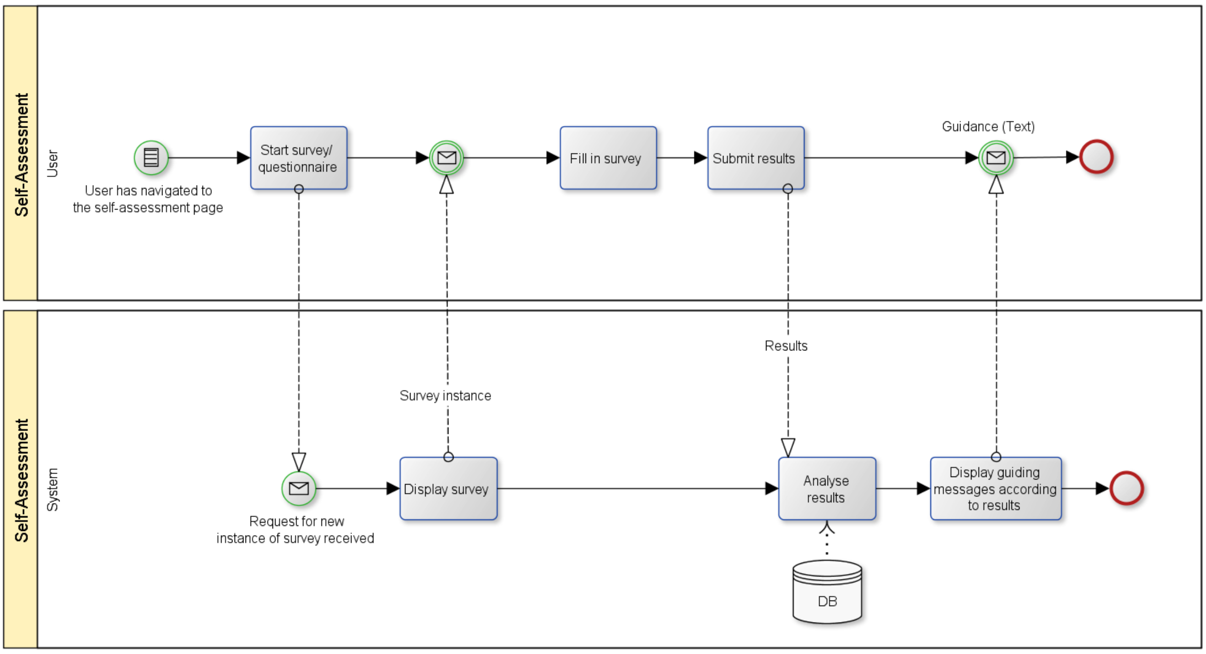
7.10 Reports

Name of the Use Case:	**UC10: Regular Reports**
Summary	User can receive periodic reports about his consumption
Normal flow of activities	Web application generates report Report is sent periodically to tenant by email
Alternative Flow	Report is sent periodically in paper
Trigger	User wants to receive periodic reports about his consumption
Precondition	Metering equipment has been installed and account configured, reporting functions enabled
Postcondition	User receives a periodical report on his consumption.



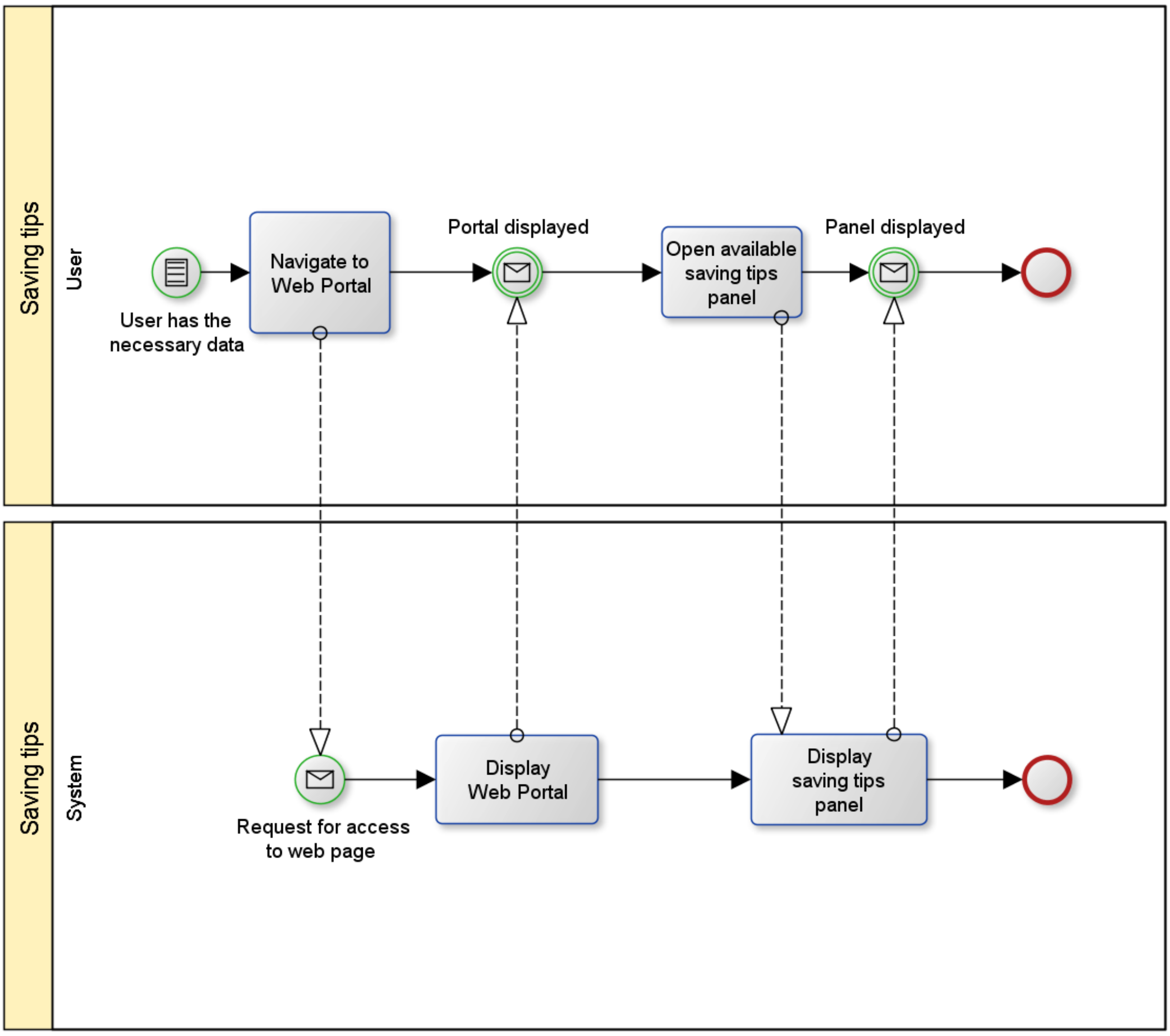
7.11 Self-Assessment

Name of the Use Case:	**UC11: Self-Assessment**
Summary	Tenant is able to assess his behaviour.
Normal flow of activities	1. Tenant assesses his own energy consumption behaviour by answering short questions 2. Tenant receives guidance according to his answers.
Alternative Flow	n.a.
Trigger	User selects the Self-Assessment page on the web portal.
Precondition	User is logged in.
Postcondition	Tenants follow the guidance received and change their energy consumption behaviour



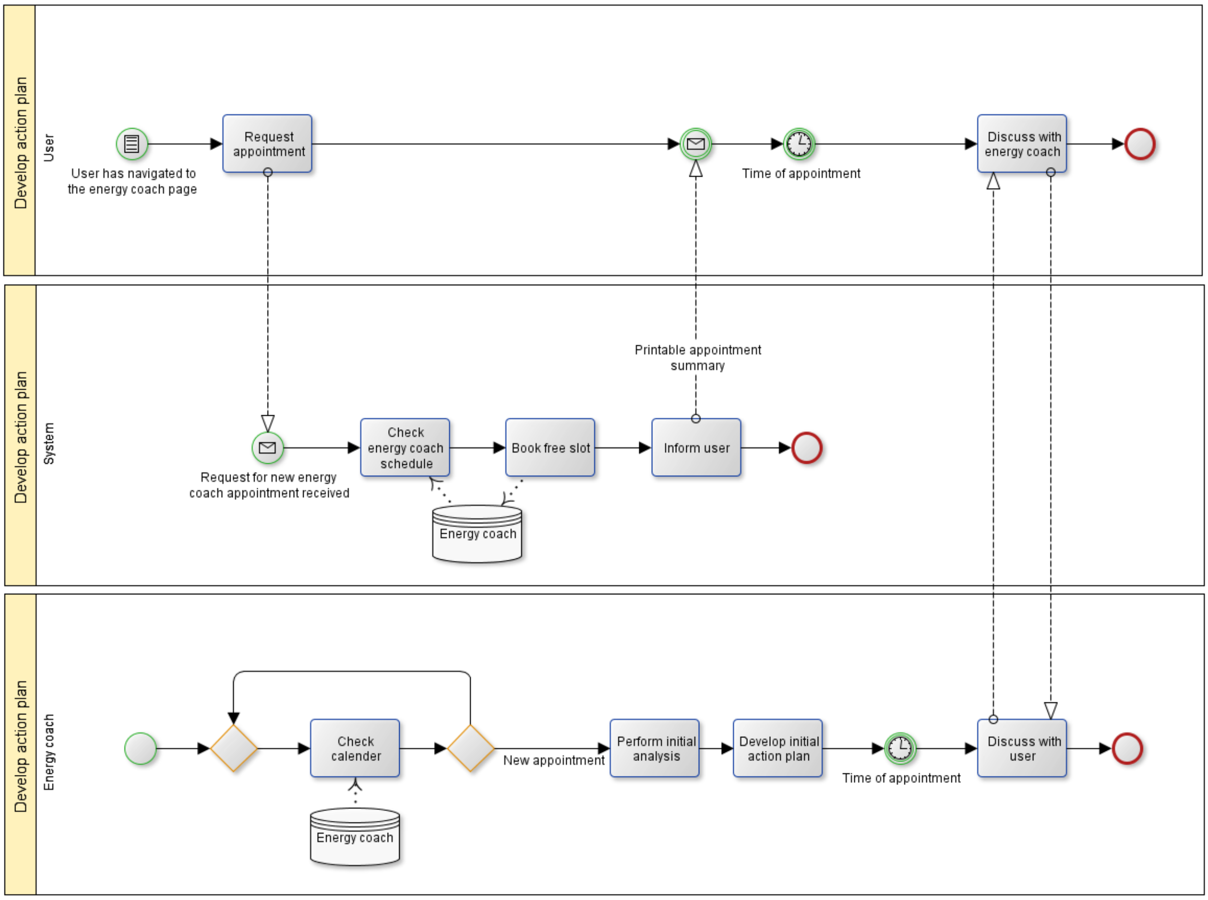
7.12 Saving tips

Name of the Use Case:	**UC12: Saving tips**
Summary	User can visualise and read energy saving tips
Normal flow of activities	User enters the web portal User opens the available *saving tips* panel in the application
Alternative Flow	Saving tips are sent in paper. Saving tips are displayed on the start screen.
Trigger	User wants to receive energy saving tips
Precondition	Metering equipment has been installed and account configured.
Postcondition	User can now access the advice-providing components of the EAS and can easily see what he can do in order to save energy.


Saving tips
User
User has the necessary data
Navigate to Web Portal
Portal displayed
Open available saving tips panel
Panel displayed
Saving tips
System
Request for access to web page
Display Web Portal
Display saving tips panel

7.13 Develop action plan (role: Energy Coach)

Name of the Use Case:	**UC13: Develop action plan (role: Energy Coach)**
Summary	On request an energy coach visits the tenant and analyses his energy consumption behaviour and explains the use of the portal
Normal flow of activities	Tenant sends request for an appointment with the energy coach. Energy coach analyses consumption data and develops an initial action plan. Tenant and coach discuss and further develop the action plan.
Alternative Flow	Tenants with high energy consumption are approached by energy coach directly
Trigger	Tenant requests an appointment.
Precondition	Energy coach has access to consumption and billing data.
Postcondition	Tenant has a plan on how to reduce consumption.



8 Overview of regulatory and legal developments in EU Member States

The following table, prepared by the SmartRegions project[5], provides an overview of the situation in each EU Member State regarding the regulatory and legal situation and the actual implementation of smart metering on the ground, as of autumn 2012.

Country	Legal and regulatory status	Implementation status
Austria Back to country table	In October 2011 the Energy Regulatory Authority issued a decree according to the Electricity Act which determines the functional requirements of smart metering systems in Austria. As expected by the stakeholders, the regulator mainly determined in this decree the topics mentioned in a catalogue with minimum function requirements for smart metering systems, which was already published in June 2010 for public consultation. In spring 2012 E-Control published a proposal for the mandatory Information of customers equipped with a smart meter. This regulation will enter into force in January 2013.	On 24 April 2012 the Minister of the Economy issued a decree, which determines the mandatory timetable for the rollout of smart metering services in Austria. The new decree will accelerate the rollout of smart meters. The main rollout of smarter can be expected in 2016 and 2017. The electricity network operators have to equip at least 95 per cent of all metering points by the end of 2019. According to estimations by the regulatory authority, there are already about 150.000 electricity customers equipped with smart meters within the different pilot projects and early rollouts.
Belgium Back to country table	No legislation regarding the introduction of smart metering yet. However, smart metering is high on the agenda of all stakeholders mainly due to late or erroneous invoices. Regional regulators have conducted various studies such as functionalities and cost-benefit analyses for all regions. General attitude in Flanders towards the (costs of) introduction of smart meters is reserved.	The focus in Belgium is on technical tests of the meters and the communication technology. A number of pilot projects are in progress or being prepared (Sibelga with 200 electricity meters, Eandis with 4,000 meters in the cities of Leest and Hombeek, some 40,000 meters by 2012 and a plan for a complete rollout of 2.5 million electricity and 1.5 million gas meters by 2019.
Bulgaria Back to country table	The Bulgarian Minister of Economy, Energy and Tourism announced during the Third Annual Conference on "Smart Grids for Power Transmission and Distribution" that the use of smart grids in Bulgaria is scheduled to start in 2012 and will help make companies more competitive.	In October 2011, CEZ announced plans to have 23,500 smart energy meters installed in western Bulgaria by the end of 2012 to help modernise its power grid and boost efficiency. CEZ has already installed more than 18,000 smart meters costing some BGN 66 million ($46.5 million) since 2009.
Cyprus Back to country table	There is no legal framework demanding a mandatory rollout, but at the same time the current legislation does not hinder the development of smart metering markets.	The Distribuition System Operator of Cyprus started a pilot project in July 2010 with 3000 smart meters. The goal is to publish a cost-benefit analysis report by July 2012. The declared strategy underlines the objective of moving towards a full rollout of smart meters for all electricity customers in Cyprus that will be based on the findings of the pilot project.

[5] http://www.smartregions.net/default.asp?SivuID=26927. The table has been slightly shortened.

Country	Legal and regulatory status	Implementation status
Czech Republic [Back to country table]	There are no legal obligations concerning smart metering in the Czech Republic. A national rollout plan is under discussion, but progress in the regulation of smart metering will depend on the results of a new cost-benefit analysis, required before September 2012. A cost-benefit analysis in 2006 led to a negative result.	Several smart meter pilot projects have been carried out or are still in progress in the Czech Republic: E.ON Česká Republika installed 4000 smart meters in South Moravia in 2006; PRE recently completed a project in Prague with 3000 meters, and ČEZ installed 2000 meters in east Bohemia. ČEZ is currently involved in FUTUR/E/MOTION, a smart grid project with 32,000 meters which will provide a basis for the cost-benefit analysis. Further rollouts are not currently planned.
Denmark [Back to country table]	Since 2005 hourly metering has been mandatory for customers with a yearly consumption larger than 100,000 kWh. There is no legal framework for the provision of smart meters for domestic customers. Mandatory metering of the electricity consumption of household customers has been suggested, but a cost-benefit-analysis led to a negative result. Minimum functional requirement for electronic electricity meters are available.	Several trials have been conducted and a number of Distribuition System Operators install electronic meters even without legal requirements. Of a total of 3million metering points in Denmark, by 2011 approximately 50% will have remote reading. Demand response is one of the main drivers.
Estonia [Back to country table]	According to the responsible ministry (The Ministry of Economic Affairs and Communications), the plan is to rollout smart meters by the end of 2017. The rollouts are led by Distribution System Operators, and the government exercises its policy to rollout smart meters through the dominant operator OÜ Jaotusvõrk. Establishing requirements for smart meters is part of the Estonian NEEAP (2006/32/EC).	The major Distribution System Operator are rolling out smart meters. The dominant OÜ Jaotusvork is having a major rollout (638,000 meters) to be implemented in four years between 2011 and 2015. After the rollouts of the largest Distribuition System Operators are ready, the national smart meter coverage should be 97%.
Finland [Back to country table]	Electricity Market Decree (66/2009) demands 80% smart meter penetration by 2014, and the Distribution System Operators are responsible for the rollout. The regulator has defined minimum functional requirements for the metering system, including hourly metering, two-way communication and load control abilities.	All Distribution System Operators have started their rollouts. Over 2million electricity meters are installed (around 1 million remain to be installed). Utilities are intensively developing and deploying information & feedback systems for their customers, along with other new smart metering-based services and developers (demand response, in-home displays, smart homes). For district heat, it is estimate that over 80% of meters are remotely readable and most of these are capable of providing data hourly.
France [Back to country table]	A government decree in September 2010 defined the terms of a mandatory rollout, aiming to achieve 95% coverage by the end of 2016. Since January 2012, all new electricity meters installed must be smart meters.	In September 2011, after several successful pilot projects, the French government announced the rollout of 35 million smart electricity meters, starting in 2013 and ending in 2018. ERDF is responsible for the deployment.

Country	Legal and regulatory status	Implementation status
	The regulator has defined some guidelines and minimum functional requirements for electricity meters. A cost-benefit analysis was carried out in 2007 with positive results.	An initial smart gas meter pilot was carried out by GrDF, installing around 18,500 smart gas meters from April 2010 to June 2011. By 2022, 11 million households equipped with gas will have their old meter replaced with a smart one.
Germany Back to country table	Germany continues to follow a market-driven policy - a government-led rollout is therefore not planned. The metering sector is liberalised. Legal obligations on smart metering have been expanded in recent years: smart meters must be installed for certain customers and in certain buildings, and utilities must offer load-variable or time-of-use tariffs. Minimum functional requirements and technical specifications are under development. A cost-benefit analysis should be completed in early 2013.	Although progress has been made with recent legislation, some obstacles to the introduction of smart meters remain. Many utilities have not yet fulfilled their obligations regarding meters and tariffs, and incentives for utilities and customers are small. An estimated 500,000 smart meters have been installed in Germany. Six pilot projects are being carried out as part of the state-sponsored "E-Energy" programme – utilities and smart meter manufacturers are gaining important insights into the technical and economic issues of smart metering.
Greece Back to country table	Greece is proceeding with a rollout of electricity smart meters and has adopted a legal framework (Article 15 of law 3855/2010). Greece has defined some minimum functional requirements and has defined two-way communication as the minimum requirement for the communication system for smart meters in electricity. A final schedule for a full rollout has not been announced yet.	The dominating Public Power Corporation (PPC) has plans to install 60,000 smart meters in large-end customers with low voltage connections, many of which are residential. This project will later be ex-tended to all customers throughout Greece. Possibilities of extending the electricity metering system to include metering water and natural gas consumption are currently being explored with the Athens Water Supply and Sewerage Company (EYDAP SA) and the Athens Gas Supply Company (EPA SA).
Hungary Back to country table	No legal framework for a mandatory rollout. But a decision is expected in 2011 with transposition of Directive 2009/72/EC. Currently there is only an obligation to provide smart meters and variable tariffs where it is economically reasonable. A cost-benefit-analysis was carried out in 2010 with the recommendation to implement a system with legally separate but regulated meter operators and to start the rollout for domestic customers in 2014. Minimum functional requirements are proposed.	Pilot projects are expected to start in 2011.
Ireland Back to country table	The regulator (CER) has almost finished a consultation process on a rollout strategy and functional requirements for electricity and gas, including a cost-benefit analysis for electricity as well as gas meters. The CER is proposing to rollout smart	The CER proposes that electricity and gas smart metering should be rolled out to all residential customers and to a significant proportion of business customers, including all business electricity customers currently with non-interval meters and all business gas

Country	Legal and regulatory status	Implementation status
	meters nationally in a manner which: ▪ Includes an In-home Display screen; ▪ Provides customers with Smart Bills; ▪ Involves suppliers offering Time-of-Use pricing; ▪ Provides prepayment services as standard with smart metering. A final decision on the national rollout is expected before the end of 2012, with the process of installing meters is likely to occur in the following years	customers. This corresponds to a total of about 2.2 million electricity customers and 600,000 gas customers. Other aspects of the proposals include the design and functionality requirements of the electric and gas smart meters, and the wide area network (WAN) and home and area network (HAN) requirements. On 5 July, the Irish energy regulator CER decided that electricity and gas smart metering will be rolled out to all residential customers and a significant proportion of small-to-medium enterprise (SME) customers.
Italy Back to country table	The installation of remotely readable electronic meters is mandatory. Minimum functional requirements are available. Focus of metering system is on reduction of non-technical losses, not energy savings.	Rollout started in 2008 and by the end of 2011 95% of 36 million customers will have received electronic meters. Data from meters can easily be displayed in home screens and become part of a more complex HEMS (Home Energy Management System), currently being tested and deployed on a pilot scale.
Latvia Back to country table	No legal framework is in place, the installation of smart meters depends on the activity of the Distribution System Operator. The current monopoly situation is not encouraging. The dominant DSO Latvenergo has developed a smart network concept (approved on 1 March 2011 by the decision of the Latvenergo Board of Directors).	Latvenergo (dominant Distribution System Operator) is preparing a concept for rollout. Conventional meters are gradually replaced by electronic meters (not necessarily AMM). 10,000 meters are already connected to the AMR system (7,000 of them are industrial customer). Latvenergo is planning to start a smart metering pilot scheme in 2012 for domestic customers. According to the plan the company will install smart meters into 500 households (which are selected by different monthly consumptions) and will implement a new MDC system.
Lithuania Back to country table	No legal framework, cost-benefit-analysis in place and no national rollout plans are available.	No activities known.
Luxembourg Back to country table	No rollout plans and no cost-benefit analysis available.	Some Distribution System Operators started with trials testing internet portals, displays, etc.
Malta Back to country table	A mandatory rollout started in 2010 to reduce the costs of bi-monthly billing and non-technical losses. Functional requirements are available.	Mandatory rollout was decided and started in 2009 with a pilot phase. In 2010 Enemalta launched a rollout plan to replace all electricity and water meters for 270,000 customers by the end of 2012. 140,000 smart meters have been replaced to date and an online portal allows customers to access to their details.
Netherlands Back to country table	The revised Dutch Electricity Act and the Gas Act (approved in 2011, in force since 2012) obliges network operators	The rollout of smart meters in the Netherlands will take place in two stages. From 2012 until 2014 a small-

Country	Legal and regulatory status	Implementation status
	(owners of the smart meters) to offer all small customers (households and small businesses) a smart meter. Customers have a legal choice over whether they accept a smart meter, ranging from having no smart meter at all to a smart meter with full functionality to provide interval data to the network operator and a chosen service provider.	scale rollout will take place for experience purposes. The small-scale rollout will take place in case of regular meter replacements (e.g. malfunctions), new meters to be placed in newly built houses/renovated houses and new meters at the request of customers. Important aspect, that will extensively be monitored during the small-scale rollout are related to technical and economic matters and the level of energy savings and smart metering services market development. From 2014, the rollout will continue on a larger scale, based on the experiences mentioned above. The large-scale rollout aims to have a smart meter fitted by at least 80% of households and small businesses in 2020, as mandated through the 3rd Energy Package.
Poland *Back to country table*	No legal framework is currently available but legislation is in progress and is expected to be ready for decision in 2012. In 2008, the regulator presented a feasibility study and presented a timetable for a rollout within 10 years.	National energy platform and smart grid consortium were founded in November 2010 to support the implementation. Energa, RWE Stoen, EnergiaPro, Enea are carrying out pilot projects. Decisions for a rollout depend on clear legal and regulatory guidelines.
Portugal *Back to country table*	No legal framework for a mandatory rollout. In 2007, the regulator presented a meter substitution plan for the period 2010–2015 and a list of functional requirements. That plan is coordinated with Spain.	The national meter replacement plan started with a pilot phase in 2010. A consortium led by EDP Distribuição started the project InovGrid. Around 100,000 smart meters have been installed in several points of the country (no geographical concentration). EDP also presented the project InovGrid in 2010 (with the InovCity of Évora as a key location, with 30,000 meters), where customers receive near real-time consumption information. In 2012 another 100,000 meters should be installed in 7 Portuguese regions.
Romania *Back to country table*	A decision on a rollout is expected in 2012. Currently there is no official plan for a rollout and a cost-benefit-analysis has not been carried out yet. The Electricity Act does not specifically refer to smart metering. The Romanian Energy Law 13/2007 has been recently updated with Article 73 introducing smart metering services but waits for promulgation. The government's strategy and the legislative position are expected to be clarified in 2012.	Some Distribution System Operators started with pilot projects. The dominant domestic operator, Electrica S.A., started with 59,000 meters. The lack of standardisation and both legal and regulatory requirements obviates further investments. The majority of pilot projects are integrated into the billing system.
Slovakia *Back to country table*	There is currently no official strategy, legal framework or cost-benefit-analysis available. A possible rollout is under	Distribution System Operators gradually installing smart meters on a voluntary basis preferably for customers with

Country	Legal and regulatory status	Implementation status
	discussion.	large consumption.
Slovenia *Back to country table*	No legal requirements for a mandatory rollout. A cost-benefit-analysis was carried out in 2008 which assumed investment costs of EUR 266 per metering point and a payback period of 11 years for total in-vestments. An update of the study was done in 2010 with positive macroeconomic results. There are no minimum functional requirements available.	So far only Elektro Gorenjska has decided to start a full-scale role out for all of its approx. 80,000 customers in 2011. Other companies have not decided on a rollout yet, but some of them are also running pilot projects. Since 2008 all industrial customers have been equipped with AMR-systems.
Spain *Back to country table*	The Energy Act of December 2007 includes a meter replacement plan for household electricity meters for the period until the end of 2018. Due to some delay in the SM deployment this Act has to be updated in February 2012 with new dates to install meters by Distribution System Operators. A set of functional requirements is available. A cost-benefit-analysis has not been performed yet.	The five main companies in Spain (Endesa, Iberdrola, Gas Natural Fenosa, Hidrocantábrico and EON) have already installed over 2,000,000 smart meters in the country. After the launching phase during 2010 and 2011, where first tests were executed, massive installation is currently in progress with hundreds of thousands of units per month. Communications and data bases are also in progress to allow remote management.
Sweden *Back to country table*	Sweden was the first country to (indirectly) mandate a full rollout of smart meters. Since July 2009 monthly meter reading is required for smaller customers with a fuse description less than 63 A. Hourly metering should be performed for larger customers. Distribution System Operators are responsible for metering. A cost-benefit-analysis resulted in net benefits of more frequent meter readings. Functional requirements are available. There are no mandatory requirements for remote meter reading of gas, heat and water.	From 2009 nearly all end customers had remotely readable electricity meters. 90% of the meters installed have the possibility of hourly metering of consumption, but they cannot fulfil requirements related to hourly settlement because of problems with daily collection and reporting of the hourly values. It is suggested that all customers should have the possibility of entering into agreements that require hourly metering free of charge, but this is not decided yet.
UK *Back to country table*	In March 2011, the Government set out the conclusions on the rollout strategy and policy design for the smart metering implementation. Mandatory rollout for larger customers until 2014 (electricity & gas), and mandate in place for domestic and non-domestic electricity & gas rollout starting from 2014 and to be finished in 2019. The main energy suppliers, rather than distribution networks, are responsible for the rollout. The current foundation phase makes the preparations needed for the start of the mass rollout, with minimum requirements for meters and displays set out in SMETS1 (sent to the EC for notification). The next Enduring Phase covers the main rollout period expected to begin in 2014, for which the minimum requirements (SMETS2) are	Few utilities are already implementing their rollouts, ahead of the national rollout schedule. First Utility and Spark Energy are offering nationwide rollouts. British Gas and Scottish Power are upgrading customers who need their old meters replaced, and also E.ON UK has started installing smart meters. The UK's largest smart metering trial Energy Demand Research Project (EDRP), with around 58,000 households, was finalised in 2011. The trial was initiated by the regulator (Ofgem). Four suppliers (EDF, SSE, Scottish Power and E.ON) installed smart meters, in-home displays and trialed feedback mechanisms, financial incentives and ToU tariffs

Country	Legal and regulatory status	Implementation status
	being developed until Sept 2012.	

9 Checklists

9.1 BECA benefits of relevance to your organisation

The checklist below allows you to check which of the potential benefits expected from BECA implementation are of relevance to your organisation. This exercise will help you design the implementation in a way which is likely to maximize those benefits that count most for you.

Which of these potential benefits are relevant for your organisation?	very relevant	somewhat relevant
Own cost savings	☐	☐
Cost saving for customers (tenants)	☐	☐
Reducing emissions of green house gases (GHG)	☐	☐
Developing the organisation’s profile as committed to sustainability	☐	☐
Managing energy networks/grids better by shifting or reducing energy consumption, e.g. reducing peak demand levels (peak shaving)	☐	☐
Gaining better knowledge about tenants’ energy consumption patterns in order to identify dwellings in need of targeted advice	☐	☐
Enabling provision of more adequate, personalised recommendations on saving energy to tenants	☐	☐
Being better able to spot energy system failures and any other klind of critical issues (in real time)	☐	☐
Developing tenants’ understanding and feeling of responsibility for energy consumption and how best to make it more efficient	☐	☐
Offering best possible service to customers (tenants)	☐	☐
Improving customer relationship management (CRM), e.g. being able to offer additional services tailored closely to customer’s preferences and needs	☐	☐
Sending customers more accurate bills based on actual consumption data rather than on estimates or average values	☐	☐
Offering energy consumption feedback through a range of channels, e.g. the Internet, in-home-displays, mobile devices, paper-based billing etc.	☐	☐
Preparing investments in energy efficiency where they are most cost-efficient	☐	☐
Integration of renewables	☐	☐
Enabling introduction of dynamic tariffs as a means to reward customers for shifting energy use to off-peak times	☐	☐
Improving load management by enabling remote adjustment of the customer’s load (e.g. briefly switching off electrical heating devices at peak times), and passing on some of the savings made possible to customers	☐	☐

9.2 Status quo assessment – What's there already?

Before planning your own implementation project, you will need to check the current status quo in terms of energy systems and energy efficiency infrastructures and initiatives. What metering systems, wired or wireless infrastructure, etc. are in place?

Use the checklist below for the stock-taking exercise. Remember that each building in your portfolio might have different characteristics, for which reason you should distinguish between each of them. Add more columns if required.

Existing infrastructure and practices	Building 1	Building 2	Building ...
Meter infrastructure			
In-home displays			
Broadband Internet access			
Tenant portal or similar on the Internet			
Telecommunications infrastructure (e.g. cabling throughout the buildings)			
Public online access (information kiosk or similar)			
Own energy generation capabilities			
Renewable energy generation			
Energy couches or similar			
In-house expertise in advanced metering etc.			
Informative billing			
Programme for awareness raising on energy saving			
Advice & education measures targeting high-consumption households			
Community initiatives on climate action			
Tenant association or similar			
Dynamic tariffs (e.g. electricity rates lower during off-peak times)			

Building Type

Building Type	building 1	building 2	building ...
Ownership / Controlled by			
Year of construction			
Year of last major refurbishment			
Storeys			
Dwellings (number)			
Residents (number)			
Total dwelling surface in m^2			
Average m^2 per dwelling			
Total community space surface in m^2			
Average m^2 of community space per dwelling			
Basement			

Building Type	building 1	building 2	building ...
Roof type			
Total m² of outside surface			
Average m² of outside surface per dwelling			
Insulation material			
U-value walls			
U-value windows			
Heating source			
Heat production (power)			
Heating Efficiency (output)			
Warm water source			

9.3 Drivers and constraints to BECA implementation

Actual drivers and facilitators at work at a given site for implementation will depend strongly on the implementation context and the local environment for investments in energy efficiency and roll-out of customer-facing applications. Use Checklist 4 to note down those drivers and constraints which are, potentially at least, of most relevance to the success of your project. (The table has been filled with some examples; modify or delete these as appropriate).

Potential drivers / constraints	Contingencies	Relevance	Implications
Political support at local level	e.g. Next elections e.g. Pressure from local business community	high⇔low □□□□□	List here
Financial support	e.g. Local/regional strategy on energy efficient buildings	high⇔low □□□□□	List here
Consumers voice increasing demand for being able to cut their energy bills	e.g. Development of the public debate about fuel poverty e.g. Sharply increasing energy prices	high⇔low □□□□□	List here
Increasing concern about climate change and carbon footprints	e.g. Any new climate-related natural disasters	high⇔low □□□□□	List here
Strong consumer interest in "smart homes"	e.g. New devices and killer applications from leading suppliers on consumer market	high⇔low □□□□□	List here
Any other potential drivers	...	high⇔low □□□□□	List here
Investment strategies focussing on the short-term	e.g. Shift in strategic focus following change in ownership	high⇔low □□□□□	List here
Financial constraints and budget squeezes	e.g. Development of economic crisis in Euro area	high⇔low □□□□□	List here
Uncertainty about upcoming regulation	e.g. Change of government e.g. Policy change resulting from failure of climate policy so far	high⇔low □□□□□	List here
Concerns about data privacy	e.g. Major incidence of privacy violation reported in the media	high⇔low □□□□□	List here
Concerns about data security	e.g. Major incidence of security leaks reported in the media	high⇔low □□□□□	List here
Lack of cooperation from key stakeholders	e.g. Shift in strategic focus following change in ownership e.g. Change of top management	high⇔low □□□□□	List here
Any other potential constraints	...	high⇔low □□□□□	List here

9.4 Checklist for identification of stakeholders to be involved

The checklist below allows you to list all key stakeholders who need to be involved (including names of contact persons) and to document the main contribution you will require from each of them. An example would be customer data -- as will be discussed below, access to data (e.g. from meter measurement) often proves to be the bottleneck for implementation.

Site:		**Building(s):**
Role	**Organisation/Contact names**	**Required contribution**
Customers = Tenants (also tenant association if existing)		
Housing Provider		
Energy Provider = Utility (a) Electricity, (b) Gas, (c) Heating [as applicable]		
Measurement Service Provider		
IT-Service Provider		
IT-Equipment Provider		
Provider of Energy Advice		
Social Insurance Carrier (i.e. party paying tenants' energy bills)		
Policy-makers		
Others:		

9.5 Stakeholder incentivisation

A good way to explore the different motivations among key participants in the implementation project is to ask each key stakeholder to fill out Checklist 9.1 (see page 149), and then to discuss the findings in a group discussion chaired by an independent moderator.

For documenting the results, you can use Checklist 6 below: List, for each stakeholder organisation, the incentives and disincentives that can be expected to influence their commitment to the project's goals, together with the actions you will need to take to create or strengthen incentives and get rid of disincentives.

If it is clear that a key stakeholder foreseen to participate in the project cannot be sufficiently motivated, you may need to seek alternative options. Otherwise, the project can be severely affected.

Stakeholder organisation	Incentives / Disincentives	Action needed
Customers = Tenants (also tenant association if existing)		
Housing Provider		
Energy Provider = Utility		
Measurement Service Provider		
IT-Service Provider		
IT-Equipment Provider		
Provider of Energy Advice		
Social Insurance Carrier (i.e. party paying tenants' energy bills)		
Policy-makers		
Others:		

9.6 Check of presentation channels according to criteria

The checklist below lets you check the feedback channels you have foreseen for your implementation against key requirements for feedback, as established in worldwide best practice. Each of the requirements should be met by at least one of your feedback channels.

	Feedback channels selected			
➔ Requirements for feedback	e.g. Mobile	e.g. Website	e.g. Letters	Implications
Feedback should be personalised	yes ☐ no ☐	yes ☐ no ☐	yes ☐ no ☐	*Write here...*
Feedback should be evolving, e.g. supporting and taking account of customers' learning process	yes ☐ no ☐	yes ☐ no ☐	yes ☐ no ☐	
Consumption data should be complemented by practical recommendations and advice	yes ☐ no ☐	yes ☐ no ☐	yes ☐ no ☐	
Need for personalisation should be balanced against customers' preferences on data privacy	yes ☐ no ☐	yes ☐ no ☐	yes ☐ no ☐	
All feedback data need to be fully consistent with billing data; if deviations cannot be avoided, suitable explanatory information needs to be provided	yes ☐ no ☐	yes ☐ no ☐	yes ☐ no ☐	
Feedback not based on kWh, but cost	yes ☐ no ☐	yes ☐ no ☐	yes ☐ no ☐	
Feedback available in real-time, but delivered by request	yes ☐ no ☐	yes ☐ no ☐	yes ☐ no ☐	
Content, quantity and style can be adapted by user to personal preferences	yes ☐ no ☐	yes ☐ no ☐	yes ☐ no ☐	
Feedback methods should be aligned with established behaviours (e.g. daily routines)	yes ☐ no ☐	yes ☐ no ☐	yes ☐ no ☐	
Customer can choose an alternative presentation channel if unable or unwilling to use the recommended one	yes ☐ no ☐	yes ☐ no ☐	yes ☐ no ☐	

9.7 BECA service requirements

Nr.	Requirement	
R-001	System/service design and dialogues should be compatible with user expectations (e.g. consistent dialogues)	☐
R-002	Users able to determine pace and sequence of the interaction with the system/service	☐
R-003	Similar functions act the same throughout the system/service	☐
R-004	Memory overload (as by multiple steps to perform an action) avoided throughout	☐
R-005	Workload minimised through well organised desktop / displays	☐
R-006	High contrast between characters and background	☐
R-007	Alerts and warning messages: flash rather than have it come on and stay on	☐
R-008	Extraneous design avoided: only relevant graphics displayed	☐
R-009	Familiar icons and symbols used, e.g. traffic lights; long text messages avoided wherever possible	☐
R-010	Positioning of labels, icons, text messages are consistent	☐
R-011	Jargon or unfamiliar terms avoided; non-technical language used throughout	☐
R-012	Text on buttons sufficiently descriptive (“send message” instead of “send”)	☐
R-013	Colours used thoroughly and adapted to needs of colour blind people. Status display (hot = red, cold = blue) complemented with associated text.	☐
R-014a	Visualisation separated for different energy sources and consumptions: electricity, gas, heating, hot water, cold water, etc.	☐
R-014b	Units of consumption: o kWh/m³ o cost (e.g. €) o CO_2	 ☐ ☐ ☐
R-015	Benchmarks offered: o historical data from previous periods (days – weeks – months – years) o average over all tenants in the building o averages from similar dwellings only (m², occupancy)	 ☐ ☐ ☐
R-016	Target setting enabled (definition of target values for hourly/weekly/monthly consumption)	☐
R-017	‘Forecasting’ data of consumption to see whether advance payments or ‘targets’ will be reached	☐
R-018	Alerts: automatic alerts are created if irregularities occur (pre-defined by user): alerts are shown if the user logs into the portal, or sent by email, or sms	☐
R-019	Regular reports are created each month and are shown in the in portal or sent by email, sms or as a letter	☐
R-020	Saving tips: the user receives personalised tips how to save energy and/or water	☐
R-021	Self assessment tool: the user is able to assess his own behaviour	☐
R-022	Frequency of consumption data visualisation requirements - Hot water: highest frequency consumption data is visualised in: hourly	☐
R-023	Frequency of consumption data visualisation requirements - Cold water: highest frequency consumption data is visualised in: hourly	☐
R-024	Media of presentation requirements for BECA pilot sites o Web o Paper	☐ ☐ ☐

Nr.	Requirement	
	o TV o Mobile app o Energy coach	☐ ☐
R-025	Individual access with username and password: Access to the service by registration introducing username and password (in compliance with regional/national/European data protection legislation)	☐
R-026	Withdrawal of consent: the user has the possibility to withdraw his/her consent and data	☐
R-027	Anonymised user data: each individual user has only access to his/her own data - if benchmark possibilities are given he/she can access anonymised data for other tenants/dwellings/buildings	☐
R-...	*List here additional requirements*	☐
R-...	*List here additional requirements*	☐
R-...	*List here additional requirements*	☐
R-...	*List here additional requirements*	☐

9.8 Use of personal data

Service		Data Subject	Are personal data involved?	Type of data processed														
				Identity data		Consumption data					Comfort and climatic data			System functioning data			
Name of the service	Type (EAS or EMS)	Building, dwelling, household, tenant, others	Yes / No	Name of natural person	Address	Cold water	Hot water	Heating	Electricity	Natural gas	Room temperature	Room humidity	Outdoor temperature	Thermal system performance	RES performance	Room thermostat set-point	Heating circuit temperatures (flow and return)

9.9 Data security and privacy

Use the checklist below for making sure that you have all major issues concerning data protection covered in your project's work plan.

Checklist data security and privacy	done	to do
Check national legislation and industry self-regulation concerning data protection in smart meter based service provision	☐	☐
Seek advice from independent data protection experts	☐	☐
Draft data protection policy	☐	☐
make sure the data protection policy covers all elements and steps of the implementation process	☐	☐
Assign independent data privacy officer	☐	☐
Inform tenants pro-actively about the main data protection issues and how these are addressed by the project	☐	☐
Train own professional staff in data security and privacy	☐	☐
Check whether third parties must be given access to tenant personal data as well	☐	☐
Obtain data subject's consent (letter of consent from all tenants)	☐	☐

9.10 Risk management plan

Risk	Estimated likelihood	Prevention and Mitigation Plan
Example: Required datasets do not become available at the expected time or quantity.	☐ Low ☐ Medium ☐ High	*e.g.: Involvement of the data owner (e.g. utility, measurement provider) as key stakeholder of the project. Involvement of local/regional government who act as champions of the project.*
Example: The integration effort is much higher than expected	☐ Low ☐ Medium ☐ High	*e.g.: This risk can be mitigated by adapting the prioritisation of system and service features, while ensuring the main objectives of the project and those with industrial relevance are fully achieved.*
Example: Delay in the implementation or deployment of components	☐ Low ☐ Medium ☐ High	*e.g.: The problem is minimised by applying several rounds of prototyping with clear early integration targets. Alternative options for key components should be investigated from the very start.*
Example: Delayed start-up due to resource or communication problems	☐ Low ☐ Medium ☐ High	*e.g.: Early kick-off involving all key partners to check appropriateness of allocated manpower and communication structure. Enable corrective actions if needed.*
Example: Service components too difficult to deploy	☐ Low ☐ Medium ☐ High	*e.g.: All components are to be subjected to usability and functional testing and full documentation should be produced of results.*
Example: Opposition to implementation on the part of a significant number of customers / tenants	☐ Low ☐ Medium ☐ High	*e.g.: Involvement from an early stage on of representatives of tenants in the implementation team. Assignment of an external expert on data protection for advising the implementation team.*
Example: Significant change in the regulatory or commercial environment, seriously affecting business case model	☐ Low ☐ Medium ☐ High	*e.g.: Business case modelling to check for sensitivity to changes of key underlying assumptions.*
Insert additional risks here, based on discussion in implementation team: ...	☐ Low ☐ Medium ☐ High	*...*
...	☐ Low ☐ Medium ☐ High	*...*

9.11 Preparation of installation and operation

Ensure that all required roles are properly covered and reflected in formal agreements or contracts, as applicable. For checking roles see Checklist 6 on page 154, which you should have completed in the planning stage already.

Formal agreements should also be made about the deadlines for service provision and finalisation of activities, see the checklist below.

Activity	Building 1	Building 2	Building ...	Comment
Prototype testing without users				
Prototype testing with users				
Dwellings: Equipment installation (a) (e.g. meters)				
Dwellings: Equipment installation (b) (e.g. wiring)				
Buildings: Equipment installation (a) (e.g. concentrators)				
Buildings: Equipment installation (b) (e.g. wiring)				
Distribution of Consent forms				
Collection & validation of consent forms				
Selection of site for on-site testing				
On-site testing				
Feedback platform (e.g. Web portal) going online				
EAS: Pilot Operation Start				
EMS: Pilot Operation Start				
add any other relevant activity here ...				
...				

9.12 Validation of service process models

Adapt the table to your individual needs.

Requirement	Description / Examples	done	to do
Clear objective of the service process	**Possible EAS objectives:** Impact tenant behaviour through the graphical provision of energy consumption data with different benchmarks offered by EAS helping the tenants to save energy **Possible EMS objectives:** Support monitoring of energy systems (e.g. heating plan) by technical housing staff members helping them to operate the system and network efficiently through active intervention of technical housing staff in heating plant operation through setting parameters based on information provided by the EMS thereby also optimising energy consumption of tenants Allow tenant to directly set heating plant and network parameters to reduce energy consumption	☐	☐
Clearly defined start and end point of the service process	Where and when should the service process start? Examples: - Date of tenant signing a rental contract with the housing company; - Tenant contract signature with the energy supplier; - Date of first meter reading of the supplier; - ...	☐	☐
All relevant steps, activities and decision points considered?		☐	☐
All relevant roles included?		☐	☐
Outcomes clearly defined?	Example outcomes of the service process: “energy saving”, “cost saving”, “reduction of CO_2”, “increased comfort” etc. or in case of EMS reduced effort of technical staff towards tenants in case of complaints which can be solved remotely significantly reducing time spent for tenants and also heating system maintenance effort.	☐	☐

9.13 Troubleshooting

At any time during service operation, problems can occur, be it with tenants, data delivery and quality or system maintenance. To prevent tenants from losing interest in the BECA services implemented, the implementation team should maintain close contact to tenants and professional users. A pro-active approach to addressing emerging problems is highly recommended.

The list below lists some scenarios from BECA pilot sites. This list is not exhaustive and should be freely extended, providing the relevant information: What problems can possibly occur, who is responsible for fixing it, what the options for mitigating actions are, and how the general implementation plan should be adapted to take account of the lessons learnt from the problem that has been faced.

No	Problem type	Problem fixer	Options for mitigating action	Implications for implementation plan
1	Tenant has doubts about web portal functionality			
2	Tenant has questions about his energy bill			
3	Tenant detects irregular or missing data in the portal			
4	Tenant detects a problem with the web application			
5	Tenant has not received monthly report			
6	Energy manager detects missing data			
7	Energy manager detects problem with the web application			
8	Energy manager wants to communicate with tenant			
9	Energy manager detects building energy system problem			
10	Utility bill shows different cost figures than what is shown in the BECA service			

Endnotes

1 World Business Council for Sustainable Development (2009) “Energy Efficiency in Buildings – Transforming the Market”, URL: http://www.wbcsd.org/transformingthemarketeeb.aspx

2 Source: ESMIG (2011) ‘A Guide to Smart Metering – Empowering people for a better environment’, URL: http://www.esmig.eu/press/publications-new/2009.09.08%20A%20Guide%20to%20Smart%20Metering%20-ESMIG.pdf/view

3 Speech by Manuel Sanchez Jimenez, Program Manager Smart Grids at the European Commission, 13 December 2012. Source: *www.esmig.eu/news-folder/press-release-esmig-and-eurelectric-report-on-latest-smart-meter-developments*

4 Source: BECA, based on ICLEI Canada (n.a.) ‘Changing Climate, Changing Communities – Municipal Climate Adaptation Guide and Workbook‘, URL: http://www.icleicanada.org/resources/item/3-changing-climate-changing-communities

5 World Business Council for Sustainable Development (2009).

6 Research by Darby from 2006 already found that most people in the residential sector only have “a vague idea of how much energy they are using for different purposes and what sort of difference they could make by changing day-to-day behaviour or investing in efficiency measures” (Darby, S. (2006) ‘The effectiveness of feedback on energy consumption’, Environmental Change Institute, University of Oxford. This finding has been confirmed by more recent studies, e.g. a survey of 2,637 social housing tenants France, Germany and Northern Ireland carried out in the context of the SAVE@Work4Homes project in 2007.

7 http://www.ofgem.gov.uk/Sustainability/EDRP/Pages/EDRP.aspx

8 Commission of the European Communitites (2009) ‘Accompanying document to the Communication on Mobilising Information and Communication Technologies to Facilitate the Transition to An Energy Efficient, Low Carbon Economy – Impact Assessment’, SEC(2009)269; See also: Darby, S. (2006) ’The Effectiveness Of Feedback On Energy Consumption. A Review For Defra Of The Literature On Metering, Billing And Direct Displays’, April 2006.

9 For example, a three-year study in **Denmark**, involving 1500 residential units (separate houses as well as flats), looked into the effects of direct feedback via metering displays, complemented by additional awareness-raising information. Savings were 10% for users living in single houses, but much smaller (1%) for residents of flats. In **Austria** a pilot project of the Linz AG, a local energy provider, resulted in 7% savings in energy consumption for heating, through implementation of an intelligent energy management tool. In a pilot project of **Norway**’s SINTEF Energy Research institute, the customers reduced their energy consumption by 24.5%. A study in the **Netherlands** in 2006 piloted an Internet-based, personalised tool with a test group of 137 private households. Results showed energy savings at the range of 8.5% compared to a control group, but also high drop-out rates among participating households. Trials undertaken by the Ontario Energy Board in **Canada** in 2006/07 indicated a 6% average energy conservation effect and critical peak load shifting (summer) by 5.7% to 25.4%, depending on the price incentives offered. A pilot study in the **U.K.** involving 120 private households, using Internet-based information about actual consumption, resulted in savings of 12% compared to the baseline scenario.

10 Stromback, J., Dromacque, C. & Yassin, M.H. (2011) ‘The potential of smart meter enabled programs to increase energy and systems efficiency: a mass pilot comparison’, URL: www.vaasaett.com.

11 Lewis, P.E. et al. (2012) ‘Empower Demand 2: Energy Efficiency through Information and Communication Technology – Best Practice Examples and Guidance’, VaasaETT, pp. 5-6. URL: http://www.esmig.eu/news-folder/empower-demand-report-phase-ii.

12 Adapted from: http://www.ien.com/article/controlling-energy-demand/7612

13 www.smartregions.net

14 www.smartregions.net

15 This section draws heavily on: http://www.euractiv.com/de/node/514483

[16] http://www.smartregions.net/default.asp?SivuID=26927. The table has been slightly shortened.

[17] Cf: http://www.guardian.co.uk/smart-revolution/safe-smart-metering

[18] Lewis et al. (2012), p. 15.

[19] Lewis et al. (2012), p. 15.

[20] Adapted from: Lewis et al. (2012), pp. 20-22.

[21] Source: Grid Consumer Collaborative (2011) '2011 State of the Consumer Report', http://www.smartgridcc.org

[22] Faruqui, A. et al. (2011) 'The Costs and Benefits of Smart Meters for Residential Customers', IEE Whitepaper, URL: http://www.edisonfoundation.net/iee/Documents/IEE_BenefitsofSmartMeters_Final.pdf

[23] Lewis et al. (2012), pp. 15-16.

[24] Lewis et al. (2012), p. 4.

[25] http://vorige.nrc.nl/international/article2207260.ece/Smart_energy_meter_will_not_be_compulsory

[26] The EDPS is an independent supervisory authority devoted to protecting personal data and privacy and promoting good practice in the EU institutions and bodies. He does so by: monitoring the EU administration's processing of personal data; advising on policies and legislation that affect privacy; cooperating with similar authorities to ensure consistent data protection.

[27] http://europa.eu/rapid/press-release_EDPS-12-10_en.htm?locale=en

[28] Adapted from: Lippincott Research, quoted in World Business Council for Sustainable Development (2009) "Energy Efficiency in Buildings",URL: www.wbcsd.org

[29] International Energy Agency (2008) 'Energy Efficiency Requirements in Building Codes – Energy Efficiency Policies for New Buildings', URL: www.iea.org/publications/freepublications/publication/name,3780,en.html

[30] International Energy Agency (2008).

[31] Lewis et al. (2012), p. 62.

[32] Yi, H., Matkin, D. S. T. and Feiock, R. C. (2011) 'Incentivizing Energy Efficiency: Explaining Local Commitment to Energy Efficiency in Cities with Municipal-Owned Utilities', Paper presented at the annual meeting of the American Political Science Association Annual Meeting, Seattle WA, September 1-4, 2011.

[33] Compare: Krause, K. M. (2011) 'Policy innovation, intergovernmental relations, and the adoption of climate protection initiatives by U.S. cities', Journal of Urban Affairs 33(1): 45-60.

[34] Yi et al. (2011)

[35] For example, see: Amram, M. & Latham, L. (2012) 'Behavior-Based Electricity Savings: Results of a Home Energy Coaching Program', paper presented at ACEEE 2012 Energy Efficiency in Buildings, URL: http://www.aceee.org/files/proceedings/2012/data/papers/0193-000275.pdf.

[36] Lewis et al. (2012), pp. 49-50.

[37] Source: ODYSSEE project, http://www.odyssee-indicators.org/publications/PDF/Buildings-brochure-2012.pdf.

[38] Lewis et al. (2012) + Stromback et al. (2011)

[39] Adapted from: Lewis et al. (2012), p. 26.

[40] Lewis et al. (2012), p. 69.

[41] Adapted from: WebCredible (2013) 'Focus groups – how to run them', URL: http://www.webcredible.co.uk/ and Work Group for Community Health and Development (2013) 'Community Tool Box', URL: http://ctb.ku.edu/

[42] Fischer, C (2008). Feedback on household electricity consumption: a tool for saving energy?. Energy Efficiency 1 (1), 79-104.

[43] ANEC/BEUC "Smart Energy Systems for Empowered Consumers," URL: http://www.anec.org/attachments/ANEC-PT-2010-AHSMG-005final.pdf. Compare: BEUC (2010) "BEUC draft response on ERGEG public consultation paper on draft guidelines of good practice on regulatory aspects of smart metering for electricity and gas," URL: http://www.energy-

regulators.eu/portal/page/portal/EER_HOME/EER_CONSULT/CLOSED%20PUBLIC%20CONSULTATIONS/CUSTOMERS/Smart%20metering/RR/GGP%20Smart%20Metering_BEUC.pdf

44 Partly based on: Cavoukian, A. (2012) 'Smart Meters in Europe: Privacy by Design at its Best', URL: http://www.ipc.on.ca/images/Resources/pbd-smartmeters-europe.pdf

45 Lewis et al. (2012), p. 1.

46 Linden, A.-L. et al. (2006). "Efficient and inefficient aspects of residential energy behaviour: What are the policy instruments for change?"

47 Lewis et al. (2012), pp. 5-6.

48 Lewis et al. (2012), p. 2.

49 See IPMVP public library of documents: www.evo-world.org/index.php?option=com_content&task=view&id=272&Itemid=60&lang=en

50 Speech by Manuel Sanchez Jimenez, Program Manager Smart Grids at the European Commission, 13 December 2012. Source: *www.esmig.eu/news-folder/press-release-esmig-and-eurelectric-report-on-latest-smart-meter-developments*

51 www.esmig.eu/news-folder/press-release-esmig-and-eurelectric-report-on-latest-smart-meter-developments

52 Lewis et al. (2012), pp. 5-6.

53 Lewis et al. (2012), pp. 5-6.

54 See Lewis et al. (2012).