Case Studies:

Results and Conclusions

D6.2 of WP 6 from the Smart-A project

A report prepared as part of the EIE project
„Smart Domestic Appliances in Sustainable Energy Systems (Smart-A)"

D 6.2 – September 2009

Written by
Dipl.-Ing. Hellmuth Frey (h.frey@enbw.com),
EnBW Energie Baden-Württemberg AG

Supported by

The project "Smart Domestic Appliances in Sustainable Energy Systems (Smart-A)" is supported by the European Commission through the IEE programme (contract no. EIE/06/185//SI2.447477).

Content

Introduction

The Smart-A project

The project „Smart Domestic Appliances in Sustainable Energy Systems (Smart-A)" aims at developing strategies how smart domestic appliances can contribute to load management in future energy systems. In order to do this, the project assesses the options for load-shifting by a variety of appliances across Europe and compares these with the requirements from energy systems both on the supra-regional and the local level. It is expected that these systems will have to integrate larger shares of renewable energy in the future, which are partly intermittent, and therefore will require a smarter management of generation, network capacities and demand.

The technical aspects of the assessment include an analysis of potential changes to appliances operation, of characteristics of local energy generation (from renewable energies and also cogeneration) and of load management requirements in the larger electricity networks. The project also features a detailed assessment of the acceptance of smart appliances operation by users, and an evaluation of the usability of available control technologies and communication standards. The overall potential of smart appliances is assessed based on a model which takes into account the variations of appliance use and the framework conditions in energy systems.

The project is conducted in cooperation with manufacturers of appliances and electric utilities. The findings from the analysis are being tested with experts in regional case studies in selected European countries.

This report

The report of WP6 compiles the results of the different case study workshops which took place with experts in four different countries in Europe: Germany, United Kingdom, Italy and Sweden. The objective of these case studies was to gain feedback from stakeholders in the four countries to the concept of Smart Appliances and to discuss the specific framework conditions for this concept for each of the countries, which can be seen as representing larger regions of Europe. A comparison is made between similarities and differences in these four different regions. In this context we consider "region" not in a very local meaning but at least on the level of countries. A classification of specific regions in Europe will be given in Tab 1.

1 Conception of the case study workshops

1.1 Conception of workshop series

According to the work programme of WP 6 there are series of workshops to be held in four countries. These workshop series was supposed to be finished before the end of 2008. In the beginning of the project the idea was to organize three workshops per country. Due to some delays in the WP 6 time schedule we only conducted three workshops in Germany. The number has been reduced to two workshops for each the UK and Italy and one workshop has been held in Sweden. The project structure is shown in Fig. 1.

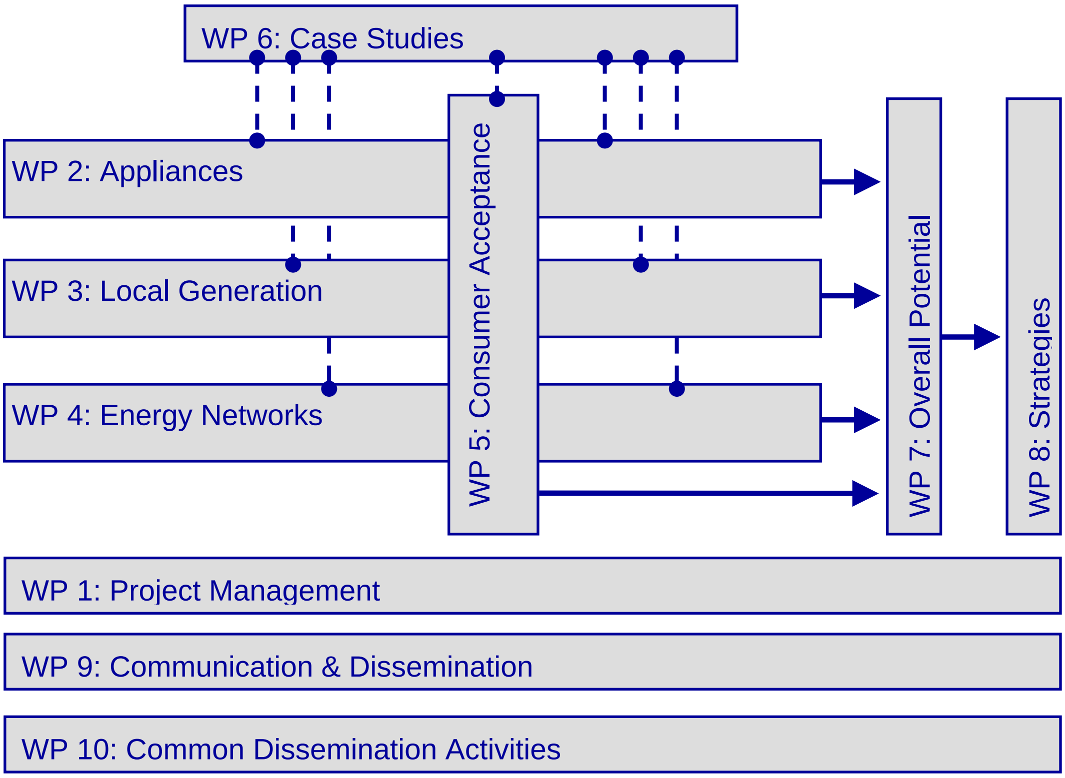

Fig. 1: Structure of the Smart-A project

WP 6 ran in parallel to work packages 2 through 5. It examined the implications of a coordinated operation of domestic appliances. It was a kind of reality check for recommendations of individual work packages and the feedback of industry experts was taken into account by the other work packages.

Countries:

The Smart-A project made a classification of different regions in Europe which is shown in Tab. 1. These regions are classified by a different share of generation flexibility, of demand profiles, of intermittent generation and of the relevance of local energy systems. Therefore the regional aspect of the Smart-A project refers to this classification of European regions.

Tab. 1: Classification of different regions in Europe

	Region A “South Europe”	**Region B** “Scandinavia”	**Region C** “New Member States”	**Region D** “Germany/ Austria”	**Region E** “UK”
Workshop in country	Italy	Sweden	None	Germany	UK
Generation flexibility	Low	High	Medium	Medium	Medium
Demand profiles	Summer Peak	Winter Peak	Winter Peak	Winter Peak	Winter Peak
Share of Intermittent generation	Medium (rising)	Low (rising)	Low (rising)	High	Low (rising)
Relevance of local energy systems	Low	Medium	Low	High	Low

To cover as many different combinations as possible, we decided to conduct the workshops in Germany, United Kingdom, Italy and Sweden.

Participants:

The participants for the workshops were stakeholders of all different branches which might be relevant for smart appliances, i.e.:

- Appliance manufacturers
- Electric utilities, Transmission System Operators (TSO’s), Distribution System Operators (DSO’s)
- Consumer organisations

- Renewable energy generators
- Manufacturers of (building) energy management systems or control techniques
- Manufacturers of renewable energy or micro-CHP-devices; fitters/installers
- Authorities (e.g. regulators)
- Trader/retailer of domestic appliances
- Other relevant stakeholders

Finally, all WP leaders have also been invited to attend the workshops. The group of participants attending these one-day-workshops in their country was expected to be about 12 to 15 people.

The dates and locations of the case study workshops are shown in Tab. 2.

Tab. 2: Dates and locations of the case study workshops

Country (Region)	Workshop Nr.	City	Date
Germany (Region D)	1	Stuttgart	2008-02-18
	2	Stuttgart	2008-10-13
	3	Stuttgart	2009-03-05
Italy (Region A)	1	Foligno (Umbria)	2008-10-06
	2	Foligno (Umbria)	2008-11-17
United Kingdom (Region E)	1	London	2008-10-20
	2	Manchester	2009-03-13
Sweden (Region B)	1	Stockholm	2009-03-17

1.2 Goals of the workshops:

The major aim of the workshops was to provide a platform for discussions between the participants and enable them to check and evaluate the content and the results of the other work packages. The goals were:

- Reality check for Smart-A: how is the idea, the concept, the project?

– Evaluation of state-of-the-art in technology and markets concerning Smart-A in the respective country (e.g. which appliances could be integrated, how are the local conditions of the electrical grid, is distributed generation (DG) available, which kind of DG, etc.)
– Collection of goals and ideas from all relevant stakeholders in different countries related to the Smart-A concept
– Identification of problems and barriers
– Development of solutions
– Comparison of the situation in different European countries

1.3 Story line of the workshop series:

The following points give a short overview of the main content of the workshops series. After this the detailed agenda of the three workshops is shown in Tab. 3 to Tab. 5 for the case of Germany. The agendas of workshops 2 and 3 were merged into one workshop for the United Kingdom and Italy, and in Sweden all issues have been covered at a higher level in just one workshop.

Short overview over the content of the three workshops:

– 1st WS: Presentation of the Smart-A project, installation and get-to-know of the local network of experts, collection of information about the regional situation concerning Smart-A, identification of regional criteria for Smart-A, if applicable presentation of first results of the questionnaire of WP 5 (consumer research)
– 2nd WS: Consolidation of specific aspects (appliances, households, electricity networks and distributed generation) according to the progress of the other WP, presentation of results from modelling (WP3+WP4), questionnaire and focus groups (WP5)
– 3rd WS: Presentation and discussion of the results of modelling, business models, constraints and strategies and a discussion of possible deployment strategies

Detailed conception of the 1st workshop

The first workshop was a one-day workshop from 9.30 am to 4.00 pm. Selected participants were asked during the preparation of the workshop for delivery of some statements concerning the situation of Smart-A in the region and related activities.

During the discussions the following points were addressed, considering important framework conditions which could be different in the various regions:

- Specific conditions on the market for appliances
- Preferences of users in the region
- Structure of the electricity network
- Flexibility of electricity generation
- Regional technologies used for local energy generation
- Regulatory framework for electricity generators, distribution network operators and energy rates

Another interesting point to evaluate during the discussions is the following situation: The concept of smart appliances is not completely new, but it is not yet well developed in practice. Therefore the following points had to be identified and analyzed during the series of workshops:

- Which parts of the project are already available?
- Which have to be developed?
- Why the technology is not yet further developed?
- Why is the technology not further known in the population?
- Where is the gap? How could it be closed?
- Which obstacles have to be removed? How?
- Are any regulatory framework conditions missing?

2 Relevant results of the case study workshops

During the workshops we showed selected preliminary or final results of the Smart-A project in order to inform the regional experts about the current situation in the project and, of course, to start the discussion about the relevant topics. In this report we do not list the presentations of the results of the project team, because the description and evaluation of these results is contained in the reports from the relevant work packages. In this chapter we have summarized the content of the discussions we had with the regional experts about the feasibility of the Smart-A concept. At the beginning of chapter 3 we have put together the main concordances and differences of the workshop series in a table.

2.1 Germany

2.1.1 CO_2 reduction and energy efficiency

In Germany CO_2 reduction is a key policy driver. For a mass implementation of smart appliances it will be necessary to communicate why smart appliances help to reach the political aims concerning a reduction of CO_2 emissions. So the focus should be on the system and not only on the individual appliance.

Another important driver is energy efficiency. The efficiency labelling scheme (i.e. A, A+) raised the consumers' awareness. So in the meantime a low energy consumption of appliances is a key selling argument. But smart appliances themselves can not lead to a further reduction of the energy demand and could even increase it to a limited extent. But the information provided by smart appliances can help consumers to save energy in the context of the overall energy system.

The main question is who will be the driver for the smart appliances. The consumer wants to have a benefit. But at the moment an energy efficient refrigerator for example leads to higher savings than smart appliances. The consumer first wants to save money and then he cares about environmental aspects. People are mainly cost-driven.

In Germany for example the DNO equivalents are not obliged to roll out Smart Meters, however the consumers have a legal right to ask for dual-rate meters. But by the end of 2010, German utilities companies must offer on-peak/off-peak rates. This might make load shifting more interesting for customers with smart appliances.

2.1.2 Consumer

The consumer's point of view is certainly very important. Consumer education activities should communicate the different values of energy at different times. A smart avant-garde of consumers is not sufficient in order to boost a mass market. A better way to increase the demand for smart appliances will be financial incentives. The consumer must spend time to use smart appliances, so it will be necessary to decrease complexity as far as possible. Without a clear financial benefit a sustainable change of behaviour will not take place. The consumers' buying decision should be influenced by the life-cycle costs in total instead of taking into account only the energy consumption of appliances.

Today the potential money savings are higher when eco-efficient appliances (class A or A+) are used compared to the benefit of smart appliances.

Smart meters are a chance to create transparency concerning the energy consumption. Today smart appliances are only to be brought to market by additional functions like for example safety aspects. Standby consumption has to be minimized and has also to be considered under standardized calculation measurements for efficiency labels.

A problem could be that smart operation of appliances will first of all produce economic benefits for energy suppliers. This benefit has to be shared with all participants, most importantly with producers of smart appliances and the smart consumers. Especially the electricity industry is interested in demand flexibility and so it is of high concern to increase the flexibility of load. Smart-A can contribute to this objective.

The benefit of smart appliances must be obvious for the customer and the tariff systems should not be too complex.

The consumers in principle tend to agree that the energy supplier will be able to influence the operation of appliances, but they do not want to loose control over their devices. The system has to be simple, because the consumer should not stop to use the technology after a short while because he looses interest in this application. At the time being most consumers do not want to think about load management, this topic is not well known in the public. If utilities need the integration of customers for a better load management, they will have to teach them and to provide the relevant information in a comprehensible way.

Complete external control seems to go too far for most users. The external signal can only be seen as an incentive. The final control about the operation of the appliance must always be left to the appliance itself, depending on its operational state. Also the devices should work autonomously, because most communication systems can not guarantee continuous operation. The appliances need at least a "fail-safe" operation mode in case that communication to e.g. a central energy manager breaks up. The user's behavior in relation to the appliances has to be included. For example many consumers will not use start time timers for washing machines because users normally want to take the washed clothes out for further processing.

Nowadays the refrigerators temperature varies already in a wide range. So it will be possible to control them automatically with the consumer having the chance to keep his own influence, because the consumer does not want to be dependent from his utility.

A fair distribution of benefits is complex to achieve. In reality it is most likely that the main profiteer will take action to initiate the systems. For the benefits it is important to create a WIN-WIN situation. This topic is becoming more and more important with a higher share of renewable energies.

As a first step it will be necessary to get the consumer used to a higher flexibility of the operation of his devices in general. For this a time-of-use tariff could be too slow, maybe a higher flexibility of pricing and billing has to be developed.

2.1.3 Technical aspects

Many things are going on in the field of smart metering. The developments should be better coordinated and standardisation is a key factor for a successful market introduction. At the end there may not be the one and only standard, but a certain number of relevant standards.

Currently the available appliances which are connected by a communication infrastructure are quite expensive. For availability on the mass market the control functionalities must be simplified. Actually the costs for smart appliances have to decrease or the benefit from their operation has to increase significantly.

An important step for the introduction of smart appliances might be the change from today's standard load profiles to an exact demand forecast. This is useful especially for a better integration of renewable energies into the grid. This also includes a total conversion of the billing system: every household would be treated in terms of measuring the load like industrial customers today.

The efficient use of the national grid versus a grid extension is an often discussed issue. Smart appliances can be helpful to reach the goal of an optimization of the grid control and the development of optimized grid structures for a reasonable integration of renewable energies. They can also help to defer or avoid the extension of existing grids.

Another point is that the feed-in of renewable energies is prioritized which leads to the fact that under today's regulation there is no difference between a varying demand by high or low energy generation from renewable energies. This regulatory situation might need to be changed in the next step.

The cost of the distribution grid are regulated, therefore today there is no margin to finance any kind of funding of smart appliances.

But it is very important to organize the smart use of appliances in a way that there is no danger of new load peaks or even higher peaks at other times due to load shifting. To avoid such new peaks the appliances should be switched in cascades. Furthermore it is necessary to develop a management system, which controls the in-house energy production, e.g. based on CHP systems in an intelligent way.

Smart systems are expected to play a role only in niche markets in the first step. Mass market introduction is considered as realistic between 5 and 10 years. Today the costs are too high and therefore are a major constraint.

2.1.4 Heating systems

The own consumption of locally produced electricity, like using Micro-CHP, gives higher values than feeding surplus energy to the grid. To follow this strategy smart appliances are needed. In many countries local electricity production of renewable energy is fed into the grid solely because it is financially supported.

Electric heat pumps could be included in the study as well. In combination with thermal storage systems these could help to shift electric demand. The washing machine should not be connected to hot water supply alone. Some washing cycles require even cold water. As an alternative to a purely cold water supply, we need two water supplies (cold & hot). Such appliances are available, but their costs are approx. 100 € higher. This is only interesting in combination with solar thermal collectors which can supply hot water temperatures higher than 55°C.

2.1.5 Standardization

Every standard in the field of smart appliances, smart metering, information and communication technology and the interaction of all these different parties is better than none. The problem is that normally the technology comes first and then standards are developed. So it is important that the relevant stakeholders agree soon on a certain standard.

The in house communication could realistically only be realized by GSM/GPRS or powerline, a communication based on separate cables is considered as not feasible within the existing infrastructure.

Data protection and data privacy are very important issues. There are consistent regulations necessary. Especially the questions which data are submitted and who has access to these data, have to be answered accurately.

It is important to have smart metering and a mass implementation of these systems. For this development relevant standards are needed.

2.2 Italy

In Italy there is no research concerning demand control by smart appliances. The present research focuses more on production management by decentralized systems.

Smart metering is deeply developed thanks to ENEL Distribution that has installed electronic meters for each user.

AEEG, the Italian authority for electricity and gas, wants to push users to change habits on energy consumption. A smart metering system records the daily consumption so it might be possible to introduce different tariffs and interested users can shift their electric consumption to cheaper tariffs (night, weekend). Smart metering permits to control the quality of electric heating, to interrupt the heating devices, to manage the reduction of overload in the summer by switching-off progressively specific devices and to manage black-out risks.

In Italy a big problem is the short-minded attitude of many authorities and consumers. In Italy there are a lot of technological deficiencies which might make the operation of smart appliances interesting, e.g. quite a weak grid compared to many other European countries. This is why a change of mentality is urgently needed together with an increased level of efficiency of devices and the overall system.

Electricity bills in Italy are 40% higher then in the rest of Europe. Nowadays the Italian government is carrying out a nuclear power policy to become more independent from gas import. Many Italian people do not have an well developed environmental culture. Every summer people use more and more energy for their personal needs, i.e. air conditioning. The first and most important step is to change the mind of people and lifestyle habits.

The use of smart appliances is hard to understand. The consumers want to have complete control over their use of household appliances. Now it is essential to optimize these for consumers, because there is quite a lot of equipment which must be replaced within a short while, like electric water heaters and incandescent lamps. Lower bills would be an accepted incentive for consumers.

2.3 United Kingdom

2.3.1 CO2 reduction and energy efficiency

In the UK there is an installed wind capacity of 26 GW. It is essential to create a demand side management for an optimized integration of fluctuating wind energy. There is a revolution necessary in the grid concerning information and communication technologies. These new technologies are necessary for demand side management which might have an impact on higher energy efficiency. Today the demand is not controlled; the energy has to be generated in time. Therefore the utilization of generation capacity is only about 55% of the installed power. The introduction of demand side management improves an adoption of (household) consumption to the actual generation situation and therefore also to minimize the redundancy of the system. If there are new investments made for a more intelligent operation in the system, this might bring benefits for the operation of smart appliances. This could lead to an improvement of the system operation efficiency.

Load shifting itself may generate new peaks when the appliances are coming back to the grid. The dynamic change of energy demand for a better integration of renewable energies might destroy the diversity. A smart switch off is not enough, the appliances also have to be switched on again in a smart way.

The opportunities for avoiding shortages are building new power plants, switching off a number of customers or looking for devices which could be delayed for some hours (such as smart appliances).

For an increasing installation of wind energy there is also enough conventional generation capacity to be operated in order to provide sufficient reserve margins. Demand side management might help to reduce CO_2 emissions, because it can reduce the need for part-loaded fossil power plant operation and it increases the ability of a system to take up wind generation.

It was noted that in the UK, there is a huge push for hot water washing machines in terms of energy efficiency, but it was pointed out that whether this is energy efficient depends on the individual home's method of hot water preparation.

Smart appliances could also fit into the idea of 'zero-carbon homes'. UK government aims for all UK homes to become zero-carbon buildings by 2050.

Will smart appliances generally have a chance and would they improve renewable energy network integration? It was recognised that something drastic needs to happen, and energy usage reduction is possibly only a part of it.

The only way to meet 2020 targets is to match demand to supply; with smart appliance introduction it would be possible for a share of 70% of electricity to be generated from wind.

The open question was also asked about how other emerging technologies would affect these matters e.g. battery-electric or hydrogen vehicles.

2.3.2 Consumer

Another important question is how the benefit should be transferred to the different participants in the system. There are already projects to analyze dynamic response of the demand and to test how the network operator can manage the network to meet peaks.

Consumers also say that a monitoring of these devices by the grid operator would be accepted if a good data protection is guaranteed. Relevant data should be also available for the consumers.

The big challenge is therefore to educate the customers to change their habits and to accept using delay functions of appliances. There is a high tolerance of surplus costs if the incentive schemes allow for a payback period within 3 to 5 years.

The most important issue for manufacturers of control systems and relevant white goods is how to actually sell their products. Today energy saving devices are more profitable then are energy shifting devices. Load shifting currently does not yet provide a sufficient economic benefit.

The calculated results were savings per fridge of about 1 to 3 GBP and 20 to 30 kg CO_2 per year.

There are incentives offered by some utility companies in the UK whereby customers submitting their own meter readings were eligible for a reduction in their standing charge. Another interesting aspect is that changing energy supplier was very popular in the UK although the suggestion was made that the high level of switching rates is partly due to the same people switching several times during a year. There is an Ofgem report that cited over 100,000 changes in supplier by customers per week in the UK. Ordinarily, customers would have to give suppliers 28 days notice of change, but suppliers are increasingly tying customers into contracts that lock them in for 12/24months at a time.

Suppliers are responsible for the installation of meters in households. E.g. Electricity North West (ENW) had 2.3 million customers and so if meters were 100 GBP each this would cost them over quarter of a billion pounds. In addition, the incentive, as far as ENW was concerned, would rather be to build up apportioned infrastructure in order to be able to supply more electricity.

The question is who would pay for smart appliance technology. It could only be recommended if it is of overall benefit, so who would benefit? There would be a non-monetary benefit for government and society by reducing carbon and an economic benefit for ENW which would mean extra profit for shareholders. It also might be necessary to change legislation in order to allow for an incentive for suppliers.

The problem could occur that suppliers may wish to cherry-pick their customers if more customers profiling were carried out. 10% or 20% of consumers already use 2-rate meters with 2 separate elements.

Consumers may have negative ideas of pressing a ‘SMART button’ if it doesn’t always necessarily mean financial rewards/benefits.

A very interesting question is how owners of expensive electricity generation sites would make money if peak production is reduced. In short-term government incentives or compensation could be introduced. In the long-term, need for incentives would be avoided by the ‘rolling out’ of load balancing power generation.

In the UK there is a definite recognition that utilities need to embrace smart metering. The question is how to justify the transition. It was argued that most meters in the NW would need to be replaced. Additionally, UK consumers can buy their own meters but the process at present is complicated.

On the topic of rate-change signal, it is already possible to send out signals using current teleswitch systems, but this is not done with large groups of customers yet.

For the acceptance of smart appliances it is important that the customer always has to be in control of his/her own appliances, therefore all smart appliances should have an override switch.

A good pre-condition could be when homes actually have smart meters. This should stimulate the market for smart appliances. Contrary to this is that many people want simple solutions as these are perceived as less likely to break.

A proposal for the introduction of smart appliances is probably a subsidy which could be offered for initial SA uptake. When prices drop due to mass production, they could be introduced as standard.

Therefore it is also important that people need to know the benefits of spending the extra money, that it will ultimately give them cheaper bills.

Also, of course non-monetary benefits should be well advertised (reducing carbon emissions).

It is also a fact that if people have the right drivers they will spend large amounts of extra money for relatively small improvement. The analogy of larger, flat screen TV sets was used. The question of the right driver/marketing was left open.
In terms of tariff changing, the question is how often this would have to be done; every hour, every four hours? This could create issues with long tasks such as a two hour wash cycle.

What might motivate a consumer to choose a variable tariff if given the choice? An average user should save money on a variable tariff if averaged over a day.

Big users already use energy reasonably efficiently as small increases in efficiency result in larger profits. Small users are however responsible for massive wastage.

Domestic energy usage was recognised as the most difficult to change; with small industry it is often easier as there is a large element of public image.

2.3.3 Technical aspects

Today the national grid company bears the costs for balancing the grid. It is quite hard to say which benefit they could achieve in the future from SA. Who gets the benefit? It is also important to develop tools for the monitoring of the reaction of the system. Smart appliances compete with conventional plants running part-loaded. The most important issue for the national grid is to avoid a black-out which would cause enormous costs.

Today the situation is that about 100 MW of load is to be cut off to stabilize the grid. The penetration of smart appliances needs about 10 years.

Frequency regulation is in a time scale of less than 30 seconds. Load reduction is between 10 and 30 minutes. Today the grid can handle the situation of fluctuating energy and take care of the load balancing.

In the future we will have the new situation that more renewable energy is to be integrated into the grid. A possible solution could be to increase the flexibility of energy consumption. Virtual power plants are another solution.

An important fact is that smart metering is more and more coming to the households. It is getting popular to have price signals and to monitor the local situation of energy consumption. But the benefits of such a system might not be available everywhere. So it is really important to analyze in which regions the smart appliances should be placed. The compensation of higher costs has to be paid back to consumers within an acceptable period.

In May 2009 the British Government has set out the different options for rolling out smart metering across Great Britain. According to that all homes in Britain will have smart meters installed by 2020. Great Britain will be the first country in the world to have a replacement programme of this size for both electricity and gas meters.

Smart meters enable meter readings to be taken remotely and together with a display device to give householders real time information on their energy use. The new information smart meters provide will help consumers to see how much energy they are using and how to save money on their bills.

In the UK there has been a project quite similar to the Smart-A concept, called “Economy 7” which operated via radio signals. Suppliers had the ability to turn off supply for electric heating and water heaters. Customers were given preferential tariffs for night time use of electricity. Economy 7 had been most popular in the UK during the 1960s and 70s. It was a wireless system that was regionally controlled. Its popularity declined when North Sea gas was introduced as it was 25% cheaper than electricity for heating purposes although electricity is set to make a comeback in the near future. Economy 7 is still available though mainly in rural areas and in Scotland. Electricity storage systems are once again on the increase as newer builds are more cost effective in terms of insulation and regulation requires that high rise developments can no longer have gas supplies.

The aim of Smart-A, however, was to investigate demand flexibility rather than demand efficiency. In this context the frequency of the grid could be an interesting way to control devices such as freezers as these are quite simple to control.

The UK experts estimated that 90% of consumers used gas in the UK which means that out of 20 million homes 18 million used gas.

Energy suppliers in the UK could do more to manage load, but changes brought about by privatisation of the utilities in the 1980s meant that investment in new systems was difficult as suppliers/distributors were now fragmented. The general question is also who would pay for the necessary new systems/appliances such as SMART metering.

Currently there is a pilot scheme running looking to see whether a visual display of energy consumption within homes would lead to a reduction in demand. Even if a reduction in consumption was small per household, this could be significant in absolute terms if the technology was rolled out nationwide.

There was also a large scale smart metering scheme in Italy with an automatic reading facility. In the UK meter reading was required only once every 2 years which has proved contentious for many consumers. In the UK there are 47 million meters that need to be converted.

Another question is whether smart appliance technology should be promoted as creating new EU jobs? At present, it was suggested the issue of employment is greater on the agenda than that of climate change. The example was mentioned of German white-goods incentives creating jobs quickly.

It was observed by the group that smart meters are needed first before the adoption of smart appliances. But probably it might take roughly seven years until smart meters are properly available on the market.

Retrofitting however was mentioned as a possible solution so as not to hinder smart appliance development; the example of smart plugs was given.

In the US, smart meters are two-way: the meter sends a signal to utilities when a smart action is taken.

2.3.4 Standardization

Smart meters will mean the end of estimated bills, no more having to stay in for home readings, quicker and smoother switching between suppliers and cheaper, easier pre-payment. The manufacturers produce large numbers not only for one country. For a certain penetration standards are necessary at least on the European level.

In the EU, until now it is only possible to buy condensing gas boilers. Their introduction took around 15-20 years, and early on they were correctly perceived as unreliable. But with newer technologies, problems are more quickly obvious and so the SMART technology adoption process should go much faster.

Joint standards for cross-sector standardisation have just been agreed upon. Also, appliances have varied lifetimes; people who buy some white goods shortly before SMART systems are introduced won’t want to upgrade in a hurry. Therefore the possibility of retrofitting is suggested.

The lifetime of standards is greater than that of appliances. Also appliances and standards would have to ensure downwards compatibility.

The UK has been very slow with the introduction of smart technology even though the technology has been feasible for a while. In the future, UK electricity and gas will be smart- with ZigBee pricing information sent directly to the appliances.

Again the technology was seen as a small problem, whereas the main issues are with standards slowing things down. The smart appliance standards will take around 30 months. The question is whether we have to wait for standards. We already have CECED standards for communication between electronic devices. Another question is where the decision for smart appliance standards was ultimately to be made. Realistically we don’t have to wait for standards to be decided on, there are already standards and we just have to choose between them.

2.4 Scandinavia

2.4.1 CO_2 reduction and energy efficiency

In Sweden there is a completely different situation than in the other countries where Smart-A workshops have been conducted. Due to a high share of nuclear energy and hydro power there has been a massive change in the heating sector from the use of oil to the use of electricity.

The CO_2 discussion is limited to the transportation sector because the power plant mix is mostly clean.

2.4.2 Consumer

A very interesting appliance could be the tumble dryer. It needs 3 or 4 times more energy than a washing machine and almost all households in Sweden have a tumble dryer due to the weather conditions.

The interest concerning smart appliances is not very present yet. People prefer to buy energy efficient appliances. The concept of load management is quite abstract but interesting. An important issue is the development of a business case for the customers. The introduction of smart appliances alone will not have a strong impact. Three things have to be covered, a benefit for the consumer, consciousness to do something good for the environment and a higher comfort.

There is a general trend to make households more intelligent in the future, smart appliances can help to do that. To reach consumers positive examples are necessary, demonstration projects where the new technology is shown. The generation of a positive image is even more important than the regulatory framework. A positive image is also more important than economic factors.

2.4.3 Technical aspects

At present wind energy in Sweden is not relevant with a share of only 0.7%. But there are new projects in this field, so in the future the share will be growing. The Swedish government has announced to reach 20 TWh of wind energy in the year 2020. Therefore also in Sweden there is a strong interest to get a higher flexibility of the consumption.

Today there are some load management programs, but more for industrial processes. Also the direct heating is not controlled today.

There are already smart meters in the grid. New companies in the market also offer smart metering systems with an online monitoring of the energy consumption. But today there is no data transmitted to the utility.

In Sweden there is also a funding for the construction of renewable plants. There are no feed-in tariffs, the support is implemented as a quota obligation on energy retailers, facilitated with “green certificates”.

Benefits are obviously higher on the supply side than on the demand side. Sweden has a problem of energy transportation: hydro power is mainly produced in the North and most customers are located in the South.

The first users have to be attracted by the emphasis of the entrepreneurs. This is the best warranty that things might start to run autonomously.

2.4.4 Heating systems

Most houses have a direct electric heating or an electrical storage heating. Today investments are preferably made in heat pumps or heat recovery systems.

Households use 25,000 to 30,000 kWh p.a. including heating. Without heating they need around 5,000 kWh, partly because of the tumble dryers.

Because of the heating structure the electric consumption is always dominated by the heating systems. This means that money can not be the only incentive to motivate customers to use of smart appliances; other benefits have to be identified additionally. The solutions have to be interesting for the customers, then they will become used to it quite easily. For example the customers have also been educated to separate their waste into different fractions which shows that there is a good possibility of changing behavior.

A new situation is also the fact that the need for cooling and air conditioning is growing. There is a chance to create a new consciousness among customers for energy saving technologies.

3 Comparison of relevant results of the different countries

3.1 Overview

In Tab. 4 the main results of the case study workshops are summarised. These are discussed in the following chapters.

Tab. 4: Comparison of the main results of the case study workshops

Region	Region A "South Europe"	Region B "Scandinavia"	Region D "Germany/ Austria"	Region E "UK"
Country	Italy	Sweden	Germany	UK
Existence of smart meters	Yes, for metering and switching	In low numbers, not mandatory	In low numbers, political instructions for new buildings	Not yet, all households until 2020 (planned)
Existence of smart appliances	No, too expensive and no use yet	No, but a high potential (tumble dryers, el. heating)	Some, too expensive and no use yet	Some, too expensive and no use yet
Interest of consumers	Yes, to avoid cutting off load due to grid congestion	Yes, for financial reasons, energy efficient appliances are more liked	Little, energy efficient appliances are more liked	Little, energy efficient appliances are more liked
Interest of energy suppliers	Yes, reduction of non-technical losses	Not yet, but rising with increasing intermittent generation	Yes, for better integration of renewables (wind)	Yes, for better integration of renewables (wind)
Necessity of standardization	Yes, but not in a first step	Yes	Yes, otherwise there will not be a mass roll out	Yes, best for whole Europe
Legislation framework for load shifting	Flexible tariffs (i.e. weekend) are available	Not yet, except of day/night tariffs	Not yet (except of day/night), more flexible tariffs must be offered in the future	Flexible tariffs (i.e. day/night) are available

3.2 Existence of smart meters

Among the analyzed regions only in Italy almost every household has a smart meter. From 2006 the electricity distribution local companies had to provide an electronic-metering service. ENEL Distribution has already installed an electronic meter for each user. The main purposes are metering but also switching and cutting off load in order to stabilize the grid. However, the meters used by ENEL are not capable of controlling Smart Appliances.

In Sweden and Germany there are only a few thousands of smart meters. Smart meters are available but not mandatory. In Sweden first companies started with online monitoring of the energy consumption as a special service for the consumers. In Germany until now only a few companies offer a smart meter. There is a new legislation in Germany that from January 2010 every new building and buildings with a large reconstruction have to get a smart meter. These meters also do not have to be capable of controlling Smart Appliances.

In the UK at the moment there are no smart meters, but first approaches are made. Also from the political side there is a commitment for an full-scale introduction of smart meters until 2020.

3.3 Existence of smart appliances

Only in Germany there are already some smart appliances available, but actually they still are too expensive and until now there is no real use justifying the additional costs. The same problems have been mentioned in the workshops in Italy and in the UK where there are only a few smart appliances operating until now.

In Sweden there is a very high potential for smart tumble dryers. Due to the cold climate nearly every household has a tumble dryer, but at the moment there are no smart devices available.

3.4 Interest of consumers

The consumers in Europe today only show a small interest in smart appliances. In all countries the problem is that the people want to decide by themselves when to use their devices. In Italy smart appliances could have a significant benefit in avoiding cutting off load due to grid congestion. In Germany and the UK energy efficient applications are more liked, they are cheaper and at the moment the financial benefit is higher.

In Sweden consumers are interested in smart appliances, if the financial and environmental aspects are well communicated.

3.5 Interest of energy suppliers

In principle all energy suppliers are interested in smart appliances. Especially for a better integration of renewable energies, mainly wind energy, there are interesting new methods by smart appliances and smart grids. The ambitious renewable energy goals of the EU predict a fast increasing feed-in of renewable energies until 2020 and beyond.

In Sweden there is actually no need for smart appliances. The high share of hydro power leads to a good potential of grid regulation. But also the Swedish government wants to increase the share of wind energy from 0.7% to 20%. Then they will also need other possibilities to improve the grid regulation and smart appliances might play a bigger role.

In Italy, the main driver for introducing smart metering was the hope to reduce the non-technical losses.

3.6 Necessity of standardization

All participants in Germany, Sweden and the UK agreed with the necessity of standardization for smart meters and communication, especially for the in-house communication. For a European wide mass roll-out of smart appliances these standards should be effectual in all of Europe. That makes it easier for manufacturers, suppliers and customers.

3.7 Legislation framework for load shifting

One important point which will play a major role in the beginning is the legislation framework. It is necessary that there are special legal requirements available for smart appliances. This includes the availability and regulation of modern and flexible tariff structures as well as the correct and secure use of data and information. Today there are only day/night or week-day/weekend tariffs available.

For example in Germany the legislation framework is in progress. Soon it will be possible to offer more flexible tariffs. In Italy, Sweden and the UK the governments should also create adequate framework conditions.

The legislation plays a major role concerning regulation of tariff structures. Another interesting question is the allocation of benefits. A chance for a fair allocation of the financial benefits could be derived from “bundle” contracts which are known from telecommunication providers. Another possibility could be that the distribution of smart appliances is driven by the grid operator.

4 Conclusions and Recommendations

The series of case study workshops gave very interesting impressions on the situation in the field of smart appliances in four different European countries. There is a great variety of knowledge and interest in this topic. Whereas Italy, Germany and the UK had quite similar views on the topic, the situation in Sweden seems to be a little different. This is mainly caused by the different energy generation system in Sweden compared to the other countries. Sweden has a lot of power generation from hydro-electric and nuclear stations. Therefore the energy generation today is almost free of CO_2 and the flexibility of the generation system is relatively high. The electricity demand is fairly high compared to the other countries because of electric heating. The use of “new” renewable energy is quite in the beginning. This leads to the fact that the ideas concerning smart appliances are not so far spread out until now, although there is a high potential for the use of smart appliances by a fairly high share of tumble dryers due to climate conditions.

There are some smart appliances available in Germany and the UK, but they are not very common. In Italy it is quite a new topic at all. In all three countries smart appliances could play a major role for a better integration of renewable energy into the grid. In Italy, additionally, there is the situation of quite a weak grid. A significant increase of grid stability could be reached, when smart appliances were available and were used in a grid efficient way.

The customers today are not really aware of the benefits of smart appliances. They prefer energy efficient appliances, because with these they get the benefit immediately. Another question which has to be solved is how to allocate the cost and benefit with the customer. It will be necessary to create interesting business models sharing the benefit between the manufacturer, the customer and the utility. That is why the question who pays for the use of the smart appliances has been discussed in several workshops. For an intelligent use of smart appliances it will be necessary to develop modern and flexible tariff systems. With these the customer will be able to save money and therefore to compensate the surplus costs of the devices. An additional support has to be given by relevant legal framework conditions which have to be developed. The integration of smart metering is a necessary step in the total concept, because otherwise the metering and billing of flexible tariffs will not be possible. For the calculation of bills regarding flexible tariffs and load shifting the data has to be transmitted exactly in short periods. Therefore smart meters are indispensable.

It would be helpful if governments created incentives for a boost to mass market. Possible incentives could be co-financing models and the promotion of flexible tariff structures. These business models have to be developed by manufacturers and the utilities.

Because there are many different parties working together in this complex context, it will be extraordinarily important to create sufficient standards for an improved integration of these different partners. Last year a summary of existing standards for smart metering has been made on behalf of ESMIC (organisation of manufacturers of smart meters) and the European Commission gave a mandate for standardization to the standardization authorities. This standardization deals with the communication until the meter, the communication behind the meter (i.e. within the household) is not covered by these activities until now. This is a very special concern of Smart-A. It has also to be taken into account whether these standardization activities could be combined and integrated or harmonized, respectively.

Nevertheless, the most important point is to change minds of consumers. Energy efficiency and CO_2 reduction have to become key drivers for consumers and politics. This at least will cause the real chances for smart appliances, smart meters and smart grids which are relevant parts of an energy infrastructure of the future.