Strategies and Recommendations for Smart Appliances

D8.2 of WP 8 from the Smart-A project

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

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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 WP8 is based on the results from the previous work packages on which guidelines for all relevant groups of actors have been developed and discussed with representatives of these groups. The groups which have been identified as the key actors on the market with respect to the introduction of smart appliances are appliance manufacturers, producers of domestic energy supply systems, electric utilities (producers, distributors and retailers), large-scale producers of electricity from renewable energy sources, policy makers, consumers and their representation, standardisation organisations and providers of smart appliance information and demand managers.

The outcome of this investigation has been summarised in this report which is divided into two main parts: in the first part all factors which might hinder the success of smart domestic appliances as well as strategies to overcome these constraints are collected for each single target group. Additionally the interaction between the groups is illustrated. Based on the results of the first part guidelines and recommendations for the introduction of smart appliances have been developed which are presented in the second part of this report.

1 Critical success factors and strategies

Each one of the following sections are assigned to one of the target groups for which critical factors for a success of smart appliances as well as strategies to overcome these constraints are identified.

1.1 Appliance manufacturers

No.	Constraints	Strategies
1	Standards for communication between the actors on the energy systems (e.g. to Energy Services) are lacking. In Germany for example every Electric utility uses different signals to differentiate the various tariffs they offer.	The work on European or World-wide standards must be increased to define the connections between each actor in a smart energy system. Appliance manufacturers should take the lead, as they produce globally used products.
2	The advantages of smart appliances are not obvious and as new tariffs (for smart operations) are not available yet the benefit for consumers is not visible.	The use of timer options (start time delay or end time definition) for load shifting should be promoted, more intensive especially for dishwasher operations during the night. This would prepare the ground for an automatic smart operation. A common good communication campaign and support of “independent” organizations may be helpful.
3	Smart appliances might be more expensive than common devices as manufacturers have to implement additional features to increase security and comfort of the appliances. Additional costs may not easily be transferred to consumers: they will only accept it to a certain limit and expect a reasonable payback time.	Smart operation functions should be implemented together with other functionalities using the same hardware, e.g. consumer information and safety functions. Thus additional costs for smart functions can be justified and balanced with other improvements. Smart devices may have an additional benefit for consumers like remote monitoring or an indication on a display for the amount of CO_2 or Euros being saved due to a smart operation. Smart appliances should provide the highest technical standard for safety. Further development of energy efficient technology and implementation is needed for realising economies of scale as well as for making this technology more competitive. As utilities are gaining the biggest benefit of smart operations of appliances, incentives should be given by these utilities to the manufacturer, retailer or consumer when buying smart devices.
4	Consumers expect “module system” for additional electronic functions so in case of a breakdown they do not have to change the whole appliance. Manufacturers are expected to provide additional support for installation and to service smart operations.	Despite any additional smart functions the device must be easy to handle for the consumer, must not require special installation (plug and play) and be easy to service in case of a breakdown. A good customer support should be provided.

5	Insurance companies may not pay in case of a breakdown (e.g. leakage), when the appliance operation is unattended.	The highest level of safety standards should apply for smart appliances (to prevent breakdowns, fire or flood) if they operate unattended. A guarantee or insurance from the manufacturer must be given that covers the costs in case of a break down if a start-time-delay function is used and nobody is at home or if the device is operated from outside.
6	As smart appliances may be connected permanently to a network and be in a remote mode when waiting for a signal to start the operation the consumption in standby power might increase.	The overall power demand for smart communication must be reduced to an absolute minimum.
7	Smart appliances may operate at times when noise is more relevant.	In general the noise of appliances must be low. Especially for washing machines, dishwashers and tumble dryers a reduction of noise during the night is required.
8	Mass production needed to reduce the costs for smart functions.	Get clear commitment from electric utilities for policies to introduce smart appliances.

1.2 Producers of domestic energy supply systems

No.	Constraints	Strategies
1	As there are no standards so far the communication with manufacturers of household appliances is not easy.	The work on common standards (IEC or CENELEC) should be intensified. Joint committees might be helpful.
2	It is not clear how a surplus of heat (exceeding the needs of the consumer) produced by domestic energy systems might be used.	The use of locally produced heat should be supported in offering more applications for using heat (see level 4 options of WP2). Additionally local district heating networks should be built up. Also other options for storing heat should be investigated more intensively.
3	Competition with large scale producers of electricity from renewable energy sources might be too strong for small producers of domestic energy supply systems (e.g. local generated heat systems).	Promotion of locally produced renewable energy should be started.

1.3 Electric utilities (producers, distributors and retailers)

No.	Constraints	Strategies
1	Every utility tries to bind the consumers to his supply and communication system. This may limit the flexibility for the consumer to change the supplier. Standards for communication with households and the appliances within the households are missing yet.	Generally accepted standards for communication have to be defined between the relevant sectors (utilities, network, households and appliances). Either unique tariffs have to be developed which are interesting for the consumers and/or a flexible communication protocol is needed to link the utility to the appliance.
2	The advantages of smart appliances are not transparent. There might be also mistrust in the motives of the energy companies among the consumers. Besides they might be afraid of more complicated and less transparent energy bills.	A very transparent energy bill is necessary. It should be made clear that there are more than just financial aspects behind smart appliance operation, like CO_2 reduction, increase in the transparency of consumption and security issues. A good information campaign is needed which increases public understanding. In addition easy tariff systems have to be developed: e.g. “eco” – “non-eco” price. Maybe the amount of CO_2 savings should be indicated on the energy bill. Consumer organisations should be included.
3	Electric utilities are often seen to gain the biggest advantages due to the peak shaving potential of smart appliances. Therefore it is essential for them to find ways to make remote monitoring of appliances acceptable and attractive to consumers. Hence contractual terms will be crucial.	Benefits should be redistributed to consumers (e.g. via a short pay back of additional investment costs). Although financial incentives are most important other incentives should be looked at as well. Another option is a direct payment to appliance manufacturers which then in turn are able to offer smart appliances cheaper. Therefore a good cooperation between utilities and appliance manufacturers is necessary. The EU may support the introduction of smart appliances by setting targets, e.g. via the Energy Efficiency directive.
4	The duty to implement price signals or tariffs respective as well as the distribution of any price (or other) signal is a decisive point.	Include policy in this process to drive the implementation by rules. For the distribution of any signal a random factor is needed to provide an optimum of equal opportunities among the consumers.
5	Collecting detailed information about the energy demand of the consumer may be a challenge for privacy reasons.	Collection of this information must be limited to voluntary schemes. Transparency of the use of this data is crucial. Clear rules are needed. Consumer organisations should be involved.
6	Smart appliances require communication with utilities which causes huge infrastructure investments. In addition individual customers may need time-consuming support which enhances the costs and billing.	The use of smart communication systems (like systems for smart metering) should be generally increased, so that smart communication is not only needed for smart appliances. This might be driven by legislation to encourage energy suppliers to install smart metering (Energy Service directive). In addition smart metering should be harmonised to include the communication to a local system. For gaining the biggest effects a common European smart metering standard is necessary.

7	Consumers insist on the possibility to override external control and by doing so the effects of a smart system would be lost. For gaining reasonable effects (large amount of load to shift) from smart appliances the number of consumers who own (and actively operate) smart appliances must be large. Therefore savings may not be too small to convince consumers to use smart appliances.	Tariffs should be offered with an appeal to shift load but energy consumption should still be affordable for everybody even in peak periods. On the technological level solutions have to be found which allow appliance operations without any restriction. However it has to be considered that it is important for consumers to have full control over their appliances with the possibility to stop a smart mode or to easily modify the time interval in which the operation is desired.
8	If a scenario of locally generated and decentralised energy systems will become reality energy utilities as well as large scale producers might loose large market shares and might only be responsible for generating a base amount of energy.	To provide flexibility electric utilities and large scale producers will need to include smart appliances.
9	No clear market/regulatory framework exists. What if there is no or little demand shifting participation? How can large consumers be integrated in a smart system? How can smart appliances be aggregated? What if demand cannot be controlled and the network capacity might deliver not enough benefits. The market/regulatory framework needs to be suitable to the introduction of demand side integration.	Start of a European wide large scale activity programme to include all actors into such a kind of flexible demand network, including domestic consumers and appliance manufacturers. Consider different interests and restrictions of the market operators.

1.4 Large-scale producers of electricity from renewable energy sources

No.	Constraints	Strategies
1	Markets are not designed to deal with renewable energy systems.	Change market structures to have ‘gate closure time’ closer to energy delivery and use smart appliances to balance discrepancies.

1.5 Policy makers

No.	Constraints	Strategies
1	There are a lot of players to talk to in a smart system as well as regional differences within Europe need to be taken care of. If key actors are not involved complaints will easier come up (e.g. consumer organisations will complain if a smart action (washing, etc.) takes too much time).	Start of a European wide large scale activity programme to include all actors into such a kind of flexible demand network. For the very beginning only the key players may be involved and form a European core group. Projects on this subject should be supported, including case studies etc.
2	Smart devices may be considerably more expensive than common devices. In addition they may have today only a limited niche market, e.g. absorber technology might only be accepted by consumers who can use thermodynamic power from solar collectors or combined heat and power units.	Economic incentives for manufacturers might be created to support the development and implementation of this technology (e.g. by procurement). The same applies for house owners to increase the application of solar collectors and combined heat and power units. The government should create a frame for incentives and an incentive-system where the market itself is not sufficient to introduce smart appliances. In addition the implementation of start time delay functions in the devices should be supported by legislation (e.g. benefit in the Energy Efficiency Calculation for the Energy label). State Incentives should be only provided for start-up phase. Smart functions may be also included as regulation.
3	As the advantages of smart appliances are not obvious acceptance might be low among the consumers. As the overall effect of a smart system increases with the share of renewable energies, benefits will be gained more in the future then today.	Environmental awareness on smart appliances and renewable energy systems must be increased by a comprehensive information campaign (adverts in newspapers, TV… etc.). A clear link between the raise of renewable energy generation and flexible demand control must be communicated.
4	There are different national standards on the market or even a lack of standards for communication between the smart meter and the in house network.	Standardisation should be driven by mandates and legislation. Programmes on European level should be established.
5	Investment decisions need to have a robust forecast of political directions. Therefore decisions have to be taken of how smart appliances shall contribute to the transition to flexible demand in future European energy systems. Acceptance of remote controlled appliances at consumer level is decisive for smart systems. This needs first an open discussion of pros and cons with consumers.	A general decision is needed of how the whole topic of smart appliances should be introduced (“bottom up” (first the consumers) or “top down” (electric utilities first)). Both ways are possible and will need to be decided by the market. A clear timetable/road map is needed and case studies should be executed. Electric utilities should be required to introduce smart meters with standardized interfaces. Rules for reallocating the value of smart appliances are needed to be established. In addition rules for integrating consumers in grid controlling should be created.

1.6 Consumers and their representation

No.	Constraints	Strategies
1	There are no financial benefits for consumers today in buying smart appliances or operating conventional appliances in a smart way.	Discussions on special tariffs should be carried out with electric utilities in order to work on a fair balance of profit out of the benefits. A verification of the benefits through independent institutions might be helpful.
2	Ecological benefits of smart appliances or smart operations are not communicated to the consumer and seen as being only used as sales arguments. The behaviour of consumers might be not smart even if they have smart options within their device. Consumers are not being informed about already available intelligent technological possibilities like start time delay function, absorber technology or inverter technology and their benefits.	Consumer organisations should inform comprehensively about available technologies and their benefits regarding smart appliances. Increasing awareness will decrease cost pressure on appliance manufacturers to produce efficient devices with start time delay function, inverter technology or absorber technology.
3	Data privacy of consumers is in question.	Data protection must be guaranteed! Decentralised control does not need personal data. Criteria should be developed of how to protect consumer rights.
4	Household insurance normally does not pay for damages caused by devices when operated unattended. Consumers might also have concerns about safety issues when smart appliances are operated from an external source.	Consumers may expect guarantees by manufacturers for the safety of smart operations.
5	There should be no dependency of the consumer to stick to a certain brand (or energy utility) to run his smart appliance system. Interconnectivity of his appliances has to be ensured.	European standards have to be developed for the communication among the appliances and to the utility, for metering and the appliances themselves. A self declaration of conformity may provide a guarantee that the interconnectivity is given. Also a change of the energy provider must be possible with the same appliances.
6	Discrimination of certain user groups (e.g. elderly people) who might be overstrained by new and smart technology. It is unsure how much information has to be distributed with the appliance: people might misunderstand the function of the smart appliances.	A good and easy usability seems to be essential. Also an extensive support must be guaranteed.

1.7 Standardisation organisations

No.	Constraints	Strategies
1	Different systems on appliance, metering… etc. are already available but they cannot communicate with each other. Too many players already on the market with very different ideas for communication (protocol, independent from manufacturer etc.). The implementation of communication might be expensive.	A European core group for guiding harmonization of communication standards (e.g. for interface protocols and smart functions) in all relevant in-house activities should be set up to create standards for all Smart-A related systems. Simple and cost-efficient solutions for communication are needed (no use of proprietary technology, easy to deploy).
2	No consistent labelling for smart functions exists so far. Smart functions like timer function (start time delay) are not visible on the energy label.	Consistent labelling for smart appliances is needed, taking into account the benefits of a smart operation. Already available intelligent functions should be included short-term on the energy label to point out the benefits.

1.8 Providers of smart appliance information and demand managers

No.	Constraints	Strategies
1	Information systems are a highly competitive market and competitors keep their concepts secretly. As there are no standards for communication between the grid and the appliances the implementation of communication might be expensive and lots of different communication protocols in various programming languages will be available.	European wide standards for all Smart-A related systems have to be developed and implemented. Furthermore simple and cost-efficient solutions for communication are needed (one chip technology): technology should be easy to deploy and not proprietary.
2	Randomised distribution of a signal for smart operation might lead to dissatisfaction among the consumers as justice is not guaranteed.	Development of a priority system for the allocation of a smart signal.
3	Data privacy might be in question.	Data protection must be guaranteed.
4	There is no big economic potential unless renewable energy reaches a high level of the demand.	Collaboration with manufacturers of appliances and electric utilities is necessary.

1.9 Interaction between the target groups

Although critical success factors have been identified for and assigned to each single actor, in most cases more than one actor is involved in a strategy to overcome a constraint. Table 1.9-1~~Table 1.9-1~~ shows how the actors are correlated to each other: in the constraints and strategies of appliance manufacturers for example (1.1.1 – 1.1.8) are also electric utilities, policy makers, consumers and their representations, standardisation organisations and providers of smart appliance information and demand systems involved.

Table 1.9-1 Correlation of target groups and success factors

Constraints + Strategies No. / Traget Group	1.1.1 - 1.1.8	1.2.1 - 1.2.3	1.3.1 - 1.3.9	1.4.1	1.5.1 - 1.5.5	1.6.1 - 1.6.6	1.7.1 - 1.7.2	1.8.1 - 1.8.4
Appliance manufacturers	X		x		x	x	x	x
Producers of domestic energy supply systems		X						
Electric utilities	x		X		x	x	x	x
Large scale producers of electricity from renewable energy sources			x	X				
Policy makers	x	x	x	x	X	x	x	x
Consumers and their representations	x		x			X		
Standardisation organisation	x	x	x		x	x	X	x
Providers of smart appliance information and demand managers	x		x			x	x	X

Source: University of Bonn

The importance of mutual understanding and the need for co-operations between the actors becomes obvious. The success of smart appliances will mainly depend upon the realisation of these interactions between the target groups.

2 Guidelines and recommendations

Based on the results of the other work packages within the Smart-A project constraints which might hinder the success of smart domestic appliances have been identified and collected for all relevant groups of actors. Then strategies which might help to overcome these constraints have been developed and discussed with the actors. As the number of actors involved and of beneficiaries of smart appliances operation in future energy systems is large, key actions need to be identified which are essential to support smart appliances. Of course these recommendations have to be seen in the larger context of renewable energy systems and smart grids.

To get smart appliances alive these recommendations have been clearly addressed to someone who should take up action and have a target which is well defined and traceable. As the socioeconomic as well as ecological circumstances in the five different regions defined in this project might be different the recommendations might also be customised a little from country to country.

The recommendations in the following sections are assigned to three different categories of actions which have to be taken up:

1. “Ad hoc” action
2. “Short-term” action
3. “Long-term” action

The first category contains actions which can be implemented straightway. The preconditions are already set so that the actions might be relatively easy put into practice. To realise the actions of the second category some time for preparation is needed in advance. But as well as for the last category which realisation needs an even longer time for preparing the ground the most important point for all recommended actions is that they have to be started now.

2.1 Ad hoc action

The recommendations in this section do not need an extensive preparation period and therefore might be implemented almost immediately.

2.1.1 Information about the use of hot water

Within the Eco-Design directive 2005/32/EC options for using hot water by washing machines and dishwashers were studied under the aspect of the appliance itself. No policies were implemented to promote the use of hot water. To foster the use of hot water, some information about possible electricity savings for washing machines and dishwashers when operated with hot water should be obligatory, if the machine contains the technical facilities to make use of this hot water. This can be done by appliance

manufacturers by including information in the fiche required by the Energy Label or the instruction manual of the appliance itself. Additionally the EU Commission is asked to investigate possibilities to include the use of hot water in the energy label (EuP-directive).

2.1.2 Shift of dishwasher operation

Long before a sophisticated communication between energy producers and appliances can be realized, it is possible to enhance the use of renewable energy by appliances. The results of WP2 showed that in all regions investigated a peak energy demand of households occurs in late evening/early night. One reason for this peak is the frequent use of dishwashers at this time. By promoting the shift of the dishwasher operations into the night (in using available timer options) some energy demand can be shifted into the night period. This will reduce the stress on the power grid in the evenings, avoid peak power stations to be activated as well as reduce the number of reserve power plants being in standby. Additionally it will ease the use of renewable energy systems within the constraints of the present power grid. Finally it will point the finger to the problem of harmonizing supply and demand in the energy system and will enlarge awareness for the need of smart appliances at the consumer level.

To promote this kind of energy shifting appliance manufacturers should include an advice in their instruction manuals and energy utilities should inform their customers about the benefits of having dishwashers operated during night e.g. by using timer control means, especially for low noise emitting dishwashers.

2.2 Short-term action

The realisation of the recommendations given in this section needs some time for preparation, but they have to be started at once.

2.2.1 Off-peak period tariffs

As energy in off-peak periods may comes more likely from renewable energy sources, energy utilities should offer a variable tariff (fixed times or time of use dependent) with lower costs for off-peak electricity consumption. This would allow consumers to gain financial benefits when operating the appliance in off-peak periods. Energy utilities should be obliged to offer variable or time-of-use tariffs together with the availability of intelligent and in house communicating power meters.

2.2.2 Advanced smart meters

Smart metering is one obvious link between the energy system and the appliance itself and seen as a platform for an informed consumer with the capability to response to re-

quirements set by the energy supply. To convey signals about flexible energy demand to the consumer or the single appliances within the household smart meters need to be capable of this option. Most types of smart meters today do not provide this feature. Therefore energy utilities should extend the definition of smart meters. In addition the EU Commission should fix the requirements for smart meters in the Energy Service Directive.

2.2.3 Public signal for availability of renewable energy

The use of renewable energy by appliances can also be enhanced by shifting the operation of appliances individually by the consumer. In principle the consumer may infer from sunny weather or heavy wind that renewable energy is available. As this is usually limited to local observations and a rather simple solution, improvements can be made if an internet based signal is generated to indicate the availability of renewable. This signal may depend on the location of the customer to optimize the local generation of energy and may include other sources of energy generation, e.g. CHP as well. In using this signal for such a kind of manual load shifting the consumer will learn about the need to harmonize energy generation and demand and also the awareness as well as acceptance for the need of smart appliances at the consumer level will be enlarged.

To develop such a kind of internet signal the European Commission should launch a project to generate this kind of information, evaluate the overall cost benefit ratio and investigate the best way of bringing this signal to the customer.

2.2.4 Credits for smart functions in Energy Efficiency calculation

As household appliances are regulated under the Eco-Design directive 2005/32/EC options to enhance the use of renewable energy need to be included into this regulation. As an example a credit of 20 kWh on the annual energy consumption under the directive 2005/32/EC may be given to washing machines, dishwashers and tumble dryers when a timer function (e.g. start-time delay) is implemented. A credit of 50 kWh may be granted when the appliance can be connected to a remote energy management system. This would foster the introduction of timer and remote energy functions as the classification of the appliance in the Energy Label would be changed.

The EU Commission should launch a specific study regarding the inclusion of smart functions in the Energy Label system for household appliances (EuP directive).

2.3 Long-term action

The realisation of the recommendations in this section needs an even longer time for preparation in comparison to the short-term actions, but they also have to be started directly.

2.3.1 Cross-sector communication

As the enhanced use of renewable energy by household appliances involves at the same time the sectors of energy production, energy distribution and household appliances itself it is of highest importance to enforce the communication between the sectors thus to build up mutual understanding and co-operations. This is of decisive importance as the benefits of a flexible or enhanced use of renewable energy by appliances are generated at the household level, but financial benefits are mainly realized at the energy generation or distribution level. Only common activities can try to find business models how to share these benefits between the actors and consumers. A plan should be developed how the volume of smart appliances in the market could be scaled up.

The European Commission should start a European wide large scale activity programme developing a roadmap for the introduction of smart appliances into smart grids. As many actors as possible should be included into such a kind of flexible demand network.

2.3.2 Cross-sector standardisation

As the enhanced use of renewable energy by household appliances involves at the same time the energy production, energy distribution and household appliances itself it is of highest importance to ensure a seamless communication along this line. This can best be done if European wide or even worldwide standards for communication signals about availability or demand of energy are in place. As by now communication standards are developed almost only within single sectors, but not between the sectors, a strong signal and engagement is necessary. These communication standards should first be developed to establish a uniform digital protocol to allow easy communication between the power and heat generation side and households. In a second step uniform application protocols may be developed to allow harmonized services to be established across grid operators.

The EU Commission should launch a study to investigate in detail the available communication standards and to outline a potential common communication standard between the sectors. Finally a mandate to CEN, CENELEC and ETSI should be given by EU Commission to develop a joint communication protocol for tariff or availability signals between energy supplier, energy distributors and appliances.

2.3.3 Allocation of financial benefits

Smart operation of appliances may in some cases request from the customer to accept some limitations in the flexibility of use. Achieving this acceptance needs some benefits: either argumentative ones (ecological friendly behaviour, use of renewable energy etc.) or financial ones (cheaper machine or operation). Most effective will be a combination of both ways. As financial benefits are generated mainly at grid level, there must be a process installed to forward these benefits to the customer. This can be done by

- Offering special tariffs for smart operating appliances
- Giving subsidies for buying smart appliances.

Additionally, as economies of scale need to bring the costs for smart operations down, procurement programmes may be needed to generate a high demand for smart appliances and thus convince manufacturers to invest in the large scale production of such kind of machines.

The EU Commission and national governments should investigate models to transfer financial benefits from the grid operator to the consumer (e.g. CO_2 tax, …) and should launch procurement programmes for smart operating appliances.

2.3.4 Protect privacy of data

As a smart energy system with a sophisticated use of renewable energy by smart domestic appliances would request sharing of information about actual usage behaviours of millions of consumers the need to protect this information against misuse is obvious.

The EU Commission and national governments should introduce a regulation for privacy of consumer data when participating in remotely controlled energy systems.

2.3.5 Use of washer-dryers

Washer-dryers may be operated in a continuous mode where drying is automatically following a washing cycle. By using additional timer options this can be shifted e.g. to have the laundry done during the night and finished in the morning when the consumer can easily unload the machine. Thus the machine must have a timer function available. For any operations at night an appropriate safety level (operation without supervision) as well as low noise as and vibration are required (also when spinning). Not many machines are available on the market today.

Appliance manufacturers should develop washer-dryer with timer functions and programmes which can handle appropriate amount of loads at a time and can be run without supervision and disturbing noise and vibration. Additionally the EU Commission should rework the directive for Energy Labelling of washer-dryers (96/60/EC) based on a programme which enables continuous operation, in contrast to today, where it is assumed that the load has to be split between washing and drying operation.

2.3.6 Enhance the use of hot water by appliances

Additional options for the use of hot water from renewable energies by domestic appliances have been identified in work package 2 of this project. Further research is needed to analyse whether these options have some potential to save energy and to enhance the use of renewable energy.

The EU commission should investigate these options of hot water usage in a specific study.

3 Outlook

Integrating the recommended actions in a roadmap for smart appliances might help to get a broader view of the different phases on the way of making smart appliances a success. In a first phase the feasibility of the Smart-A concept should be verified in further studies. This phase has already been started as pilot projects in several European countries testing smart concepts in the field. Also European actors are working already on the standardisation of communication protocols and technologies in the smart metering field as well as between the gateways of smart meters and domestic appliances. The recommendations described in this report belong to this first phase.

The next phase of introducing smart appliances into the market requires significant public support and clear political targets in order to stimulate mass production of smart devices. It should focus on applications which offer a high benefit like introducing devices with a high value such as dishwashers, washing machines or tumble dryers or like introducing them in counties with low flexibility in power generation and high wind energy shares or targets. The actual effects of smart appliances in the field are to be evaluated in order to optimise the concept.

The focus is expanded in phase three where also applications with a medium benefit are taken into account. Smart appliances should then be introduced also in countries with a medium or even high flexibility in power generation and medium to high wind shares or targets. Now all appliances which offer an overall benefit should be introduced. For certain appliances, smart functionalities might become a requirement for all producers after the functions have been tested successfully. As the production numbers of smart appliances should be increasing at this point, the level of public support can be gradually reduced. The evaluation of actual effects of smart appliances in the field are continued in order to optimise the concept.

In the last phase a saturation of the market should be reached by further expanding the market share of smart appliances. Smart functionalities might become a requirement for even more producers of appliances than in phase three.