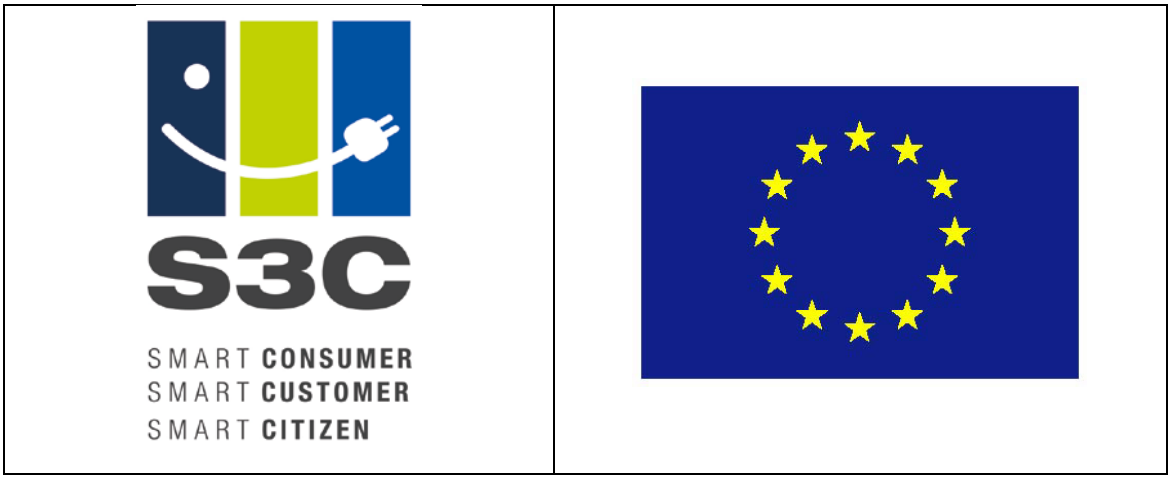

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Deliverable D5.2

Study with general and country specific recommendations for policy makers, regulatory and standardisation bodies and associations to support setting favourable framework conditions

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Abstract:

This deliverable contains recommendations from the S3C consortium for policy makers, regulatory and standardisation bodies as well as industry, its associations, suppliers and research and funding institutions to support favourable framework conditions. 25 recommendations are grouped in five domains of activity: visions and expectations, regulation, market formation, knowledge formation and resource mobilization.

Keyword list:

smart energy behaviour, psychology, sociology, smart grid projects, end-user engagement, target groups, products and services, incentives, pricing schemes, end-user feedback, project communication, stakeholders, smart energy communities, standards, research agenda, market structures, scalability, replicability, market formation, knowledge formation, resource mobilisation.

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Executive Summary

Active demand by households and small and medium-sized enterprises (SMEs) is still lagging behind. Although significant experience has been gained with pilot projects, limited success has been reported from larger scale roll-outs of smart meters as well as smart grid technology and services. The S3C project has carefully looked at multiple approaches to foster development towards “a smart energy age”. Unsurprisingly, taking people’s needs and expectations into account has been found to be key for success. But there is little experience in the energy domain on how to do so.

With its toolkit of 50 guidelines and tools, S3C has provided a sound collection of practical knowledge. However, there is still a long way to go until a majority of end users will be actively involved. Many stakeholders will have to join forces to ever better understand the needs, develop reasonable and affordable solutions to meet them and to allow them to enter the market places. So, in addition to its practical toolkit, the S3C consortium has formulated recommendations for the following 12 stakeholder groups to set the right framework conditions for enabling smart energy behaviour:

- EC legislation
- EC level research programmes
- national policy makers
- national funding authorities
- national regulatory bodies
- local authorities
- associations of energy industry
- associations of ICT industry
- associations of and for consumers
- standardisation bodies
- curriculum developers
- suppliers to energy industry.

All in all 25 recommendations have been formulated, grouped in 5 domains of activity:

- Visions and expectations: creating a common sense as to the goals and effectively communicating it
- Regulation: ensuring that the overall vision is achieved in an equitable way for the different stakeholders involved
- Market formation: shaping the European energy market including the definition of market roles following new approaches in the interplay of regulated and free markets
- Knowledge formation: building up the necessary research frameworks and formulating adequate requirements to address the remaining knowledge gaps
- Resource mobilization: mobilizing material infrastructure, investments by firms and human resources for the establishment of new business platforms offering tailored energy related services to end users.

The recommendations have been synthesized from the inputs of all S3C consortium members and resemble views of researchers, consultants and practitioners. In addition, views of the S3C Advisory and Dissemination Board have been included, which not only added to the insights but validated the given recommendations.

For a dense list of all recommendations, see the table of contents of this deliverable.

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1. Introduction

Active demand by households and SMEs is still not widely adopted in the EU today. While it has a long standing tradition in Europe's industry, other potential remains largely untapped. Although significant experience exists with pilot projects (as collected and analysed in the S3C Deliverable 3.4), little experience has been gained in larger scale roll-outs.

The implementation of the Directive on energy end-use efficiency and energy services (2006/32/EC) is one of the central prerequisites to arrive at a situation in most EU member states, in which active demand through different channels can be achieved.

Findings from pilot projects - often targeting specific end-user groups (e.g. 'early adopters') - cannot *a priori* be transferred to the case of larger scale roll-outs dealing with a much more diverse audience. The challenge is thus to understand which issues hamper and/or facilitate up-scaling or replication of smart energy projects and the rollout of smart energy products and services. The EC has formulated their own targets for the rollout of innovative products and services in the field and interest groups like the Smart Energy Demand Coalition have kept track. The present deliverable formulates policy recommendations for removing the barriers standing in the way of the smart grid rollout from the perspective of the households or SMEs involved. It builds on the expertise of the S3C consortium, on the lessons learnt from our detailed case analyses, and on advice from the members of our Advisory and Dissemination Board (ADB) and 'Family of Projects' (FoP).

1.1 Background and Rationale

Many different factors can be imagined to contribute to the successful rollout of smart grid programmes. Broadly, these factors can be grouped into the following categories:

- Visions and expectations: In terms of creating broad legitimacy for smart grid solutions, it is vital that there is a clear vision on how the smart grid market and infrastructure should develop. Furthermore, this vision should be shared between the different actors involved (industrial players, policy makers, associations, etc.), and translated into clear policy goals. Also, the communication of this vision and the importance of implementing related policy measures to end users should be a priority.
- Regulation: Regulation is needed to ensure that the overall vision is achieved in an equitable way for the different stakeholders involved (with fair distribution of costs and benefits of the smart grid rollout), also in particular taking into account privacy and security issues related to the use of end-user data. Furthermore, regulation has to offer clear definitions of different energy roles and, thus, contribute to creating a stable and reliable situation for the market actors to participate in. That means that regulation clearly addresses topics at the borderline of today's regulated and open market to ensure a quick and reliable market uptake of innovative energy services.
- Market formation: The size of end-user demand for smart grid products and services will increase. For instance, active demand management through dynamic tariffs could be one of the attractive business offerings for households in the future. Today however, the actual amount of active demand offerings on the European energy market is limited and/or insufficiently attractive. Due to the national regulation agencies' influence on market formation, this field is strongly linked to regulation. Furthermore, the traditionally dominant influencing factors on the energy market were largely dominated from the central generation point of view. Shaping the market to the changing circumstances requires new approaches in the interplay of regulated and free markets. It may as well require the definition of completely new market roles (such as aggregators).
- Knowledge formation: Building up the necessary research networks and adequate levels of funding are needed to address the remaining knowledge gaps. For instance, the S3C Deliverable 1.1 lists 9 challenges for research concerning the understanding of the end-user perspective in smart grid projects/rollouts. While many mapping exercises have tried to describe findings from projects, most of these ended up with pure collection of information and did not succeed in drawing conclusions and creating applicable knowledge. The EC's attempts to bring together H2020 projects in various working groups, projects such as GRID Plus Storage or the ERA-Net Smart Grids Plus Approach to build a knowledge community may lead the way.

- Resource mobilization: Material infrastructure, investments by firms and human resources need to be mobilized. For instance, the rollout of an advanced communication infrastructure (e.g. smart meters, in-home displays, feedback devices, etc.) will be the key enabling technology for the establishment of new business platforms offering tailored energy services to end users. Gateways that serve multiple purposes from metering to intelligent control as well as horizontal hardware and software platforms will allow for new types of applications and cost effective implementation of such services.

Actions required to scale up and roll out smart grid initiatives thus require working on multiple fronts at once. From a policy perspective, it is important to overcome the barriers bringing smart grid technologies from a technology readiness level (TRL) 7 to levels 8 and 9 through social innovations involving end users. The S3C Deliverable 1.1 reports on a variety of factors end users consider when deciding whether to engage in (and continue with) a smart grid program. These factors can be classified as either enablers (reasons why end users may be tempted to engage) or barriers (reasons why they would not).

Table 1 presents an overview of the various enablers and barriers listed in Deliverable 1.1. They are grouped in the categories (in alphabetical order) *comfort*, *control*, *environment*, *finance*, *knowledge & information*, *security*, and *social process*. Interestingly, for most categories both enablers and barriers can be identified:

- **Comfort**: Possible loss of comfort is an often mentioned barrier (e.g. Prüggler, 2013). Active demand technology as part of smart grid, smart home and smart city services on the other hand side may also increase levels of comfort, also mentioned as a potential enabler as such.
- **Control**: An often mentioned barrier to engagement is the perceived loss of control over appliances, as automated control algorithms 'take over' appliances[1] (Verbong, 2013; Bartusch 2011). Smart grid technology, however, may also extend the possibilities for control, for example, through more advanced possibilities for controlling appliances (e.g. using mobile devices), extended possibilities to participate in the electricity market (e.g. JRC, 2011), and possibilities for becoming more energy independent ('energy self-sufficiency' or 'energy autonomy').
- **Environment**: The environmental benefits of smart grid development - reducing greenhouse gas emissions by allowing for extended integrating of renewables into the grid – is a reported key benefit end users may strongly care about (e.g. SGCC, 2013). Asensio and Delmas (2015) find that giving information about the avoided environmental and health costs of electricity generation through energy conservation efforts leads to higher energy savings (the persistence of this effect is however not yet proved).
- **Finance**: It is clear that financial or 'in kind' incentives and the expectation of a reduced energy bill may be clear enablers for engaging in smart grid programs (e.g. Verbong, 2013; SGCC, 2013; JRC, 2011; Prüggler, 2013). On the other hand, engagement may also require investment costs for smart appliances, and may also lead to a higher energy bill for end users requiring electricity at peak times. However, in the long term reduced or at least less increasing energy costs may result from an early adoption of smart grid means and measures (e. g. Appelrath, 2012; Karg, 2014).
- **Knowledge and Information**: More transparent and frequent billing information and detailed knowledge about energy use by different appliances are considered a key benefit for end users engaging in a smart grid program (e.g. JRC, 2011). Yet, the lack of adequate knowledge and information provision about the smart grid program may act as a barrier (e.g. EEA, 2013). Additional barriers in this category are lack of competences to deal with new technologies or to negotiate with energy suppliers (e.g. EEA, 2013), a lack of awareness about the concept 'smart grid' and its potential gains (e.g. SGCC, 2013; Bartusch, 2011), and perceived risks like the (supposedly) adverse health effects of wireless signals (e.g. SGCC, 2013; Bartusch, 2011).

[1] A basic recommendation given is to always include possibilities to interfere / overrule automatic procedures (e.g. Verbong, 2013).

- **Safety and Security**: A typical security issue is improved reliability, often mentioned as an important advantage (e.g. JRC, 2011; SGCC, 2013). On the other hand, privacy and security concerns are reported as potential barriers (e.g. Verbong, 2013; SGCC, 2013).
- **Social process**: The positive stimuli enabled by social processes are mostly reported as enablers of end-user engagement. This concerns, for example, the stimulating effect of role models (EEA, 2013) and customer testimonials (SGCC, 2013), and the 'community feelings' and sense of competition smart grid programs may appeal to (Verbong, 2013), basically making participation 'fun'. To some extent, social values are also reported as barriers, for example through 'free rider effects' (JRC, 2011) (creation of a sense of unfairness, because non-participants of the smart grid also benefit from peak shaving) or job losses (SGCC, 2013) (as meter readers will no longer be needed) end users don't want to be responsible for.

Table 1: Possible enablers and barriers of end-user engagement in smart grid projects listed in the S3C Deliverable 1.1

Category	Enablers	Barriers
Comfort	Comfort (gain)	Comfort (loss)
Control	More energy independence ('energy autarky') Extended possibilities to participate in the electricity market More advanced control of appliances, e.g. using mobile devices.	Loss of control over appliances
Environment	Environmental benefits	
Finance	Financial or in kind incentives Reduction of the energy bill Expected potentials of long term limitation of energy costs	Investment costs Increased energy bill
Knowledge & Information	More transparent and frequent billing Detailed knowledge about electricity use	Unclear information about the smart grid program (technologies / incentives / pricing schemes) Lack of competences, e.g. to deal with new technologies or to negotiate with energy suppliers Lack of awareness about the concept 'smart grid' and its potential gains Perceived risks, e.g. adverse health effects
Security	Improved reliability of energy supply	Privacy and security concerns
Social process	Role models Customer testimonials Community feelings Competition Fun	Free rider effects Job losses

In line with the overall S3C project approach, in this deliverable we also adopt the point of view of the end users themselves (households and SMEs). Additional complexity is introduced by the fact that 'the' end user does not exist. Different target groups may be susceptible to very different enablers and barriers. The challenge is thus to understand which ones are of particular relevance, and to base policy recommendations on removing those barriers that affect the greatest number of end users – or those that are perceived as trend setters. Particularly, the present deliverable discusses how the barriers to successful end user engagement in smart grid programs can be addressed by policy-making interventions in the 5 categories outlined above.

Due to the overarching nature of our research, and the fact that the details of policy making will depend on specific national/regional context, our recommendations will necessarily be of a rather general nature, indicating the general direction for drafting more specific policy measures without tracing the course in detail. However, the relevance of our general recommendations will be illustrated by specific country-case examples where feasible.

In general, the recommendations are targeted towards those stakeholders that set the framework conditions for end user engagement in active demand programs and for the development of smart cities and smart grids. This target group comprises:

- EC legislation
- EC level research programmes
- national policy makers
- national funding authorities
- national regulatory bodies (and their European umbrella organisations)
- local authorities
- associations of energy industry
- associations of ICT industry
- national associations of and for consumers (and their European umbrella organisations)
- national and international standardisation bodies
- curriculum developers of educational institutions
- suppliers to energy industry.

1.2 Structure of the report

In chap. 2, recommendations are grouped so to address the following topics:

- Visions and Expectations
- Regulation
- Market Formation
- Research
- Resource Mobilization.

While for some topics it may be easy to identify the addressed stakeholders, it may not be as clear in other cases. For this reasons, checked boxes at the top of the recommendation specify its respective target.

	EC legislation
	EC level research programmes
	national policy makers
	national funding authorities
	national regulatory bodies
	local authorities

	associations of energy industry
	associations of ICT industry
	associations of and for consumers
	standardisation bodies
	curriculum developers
	suppliers to energy industry

2. Recommendations

The following collection of recommendations started with the S3C consortium meeting in Amsterdam, May 27, 2015. The ideas received from the consortium have been consolidated and further elaborated by BAUM and VITO. They were further developed together with the S3C Advisory and Dissemination Board (3rd ADB meeting on Sept. 23, 2015)

2.1 Recommendations related to "Visions and Expectations"

These recommendations should help to improve the general awareness and expectations of a broad society. They should help to overcome anxiety and foster the will to engage.

<table>
<tr><td colspan="3">Develop an overarching storyline to achieve a common understanding and 'sense of urgency' for smart grids</td></tr>
<tr><td>Target</td><td>
<table>
<tr><td>x</td><td>EC legislation</td></tr>
<tr><td>x</td><td>EC level research programmes</td></tr>
<tr><td>x</td><td>national policy makers</td></tr>
<tr><td>x</td><td>national funding authorities</td></tr>
<tr><td>x</td><td>national regulatory bodies</td></tr>
<tr><td>x</td><td>local authorities</td></tr>
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<tr><td>x</td><td>associations of energy industry</td></tr>
<tr><td>x</td><td>associations of ICT industry</td></tr>
<tr><td>x</td><td>associations of and for consumers</td></tr>
<tr><td>x</td><td>standardisation bodies</td></tr>
<tr><td>x</td><td>curriculum developers</td></tr>
<tr><td>x</td><td>suppliers to energy industry</td></tr>
</table>
</td></tr>
<tr><td>Details</td><td colspan="2">The general public tends to perceive energy as a low-interest topic. For many people, electricity is an invisible good, of which they are hardly aware. They have no clear understanding of what it is, how it works and what the costs are. For the future expansion of smart grid infrastructures, it can be beneficial to create a consciousness about the (external) costs of fossil and nuclear energy production for future generations and the missing sustainability of the contemporary energy system. When the advantages of renewable energies and of smart grids are in the foreground, end users may be more likely to adopt a sense of urgency that increases their motivation to participate actively.

Developing an easily understandable overarching storyline can be helpful to educate end users and improve their energy awareness, which can lead to a stronger motivation to act accordingly. Here, it is up to the authorities on a local, regional and governmental level to clearly communicate short term and long term benefits of more sustainable solutions and fight contradicting messages and inadequate anxiety.

Communication to end users should use a more streetwise language and lively examples. In addition, it is of key importance to translate the overarching story in actionable information for end users, such as energy saving tips. The importance of the smart grid in terms of the long-term transition to a largely renewable energy system should be translated in short-term stimuli. Currently, a lack of detailed, factual knowledge about the energy system often contributes to confusion and perhaps even apathy among end users. In everyday social practices, this can lead to undesirable results because people are unsure of what to do and how to do it. Practical tips – e.g. how to save on the energy bill and how to improve energy efficiency – are generally appreciated by end users. As shown in some of the case studies that were investigated by S3C (D3.4), providing non-energy information (e.g. the weather forecast) on the feedback display can be a simple yet effective way to connect in-house energy management with the everyday social practices of end users.</td></tr>
<tr><td>Background</td><td colspan="2">The barriers addressed by this recommendation are related to knowledge and information as well as lack of awareness about the concept 'smart grid' and its potential gains.</td></tr>
<tr><td>Comments</td><td colspan="2">The Advisory Board stressed the importance of conveying information of the "real cost" of various technologies (including fossil) to end users. Also, a connection should be clearly made between sustainable renewable energy solutions and the need for smart grids development. A good message to communicate could be that smart grids should enable highly decentralised production and therefore tremendously increase</td></tr>
</table>

	smaller-scale investment opportunities for citizens. Of course, this will depend a lot on a consequently implemented reform of the energy market.

Manage overall and specific customer expectations.						
Target						
			EC legislation	x	associations of energy industry	
			EC level research programmes	x	associations of ICT industry	
		x	national policy makers	x	associations of and for consumers	
			national funding authorities		standardisation bodies	
			national regulatory bodies		curriculum developers	
		x	local authorities		suppliers to energy industry	
Details	Demand-side management pilots and programs have in the past often been promoted on the premise that enabling consumers to monitor their electric consumption would effectively increase the price elasticity of demand, resulting in reduced peak loads and lower electricity bills. In addition, in many cases, smart meters were marketed to consumers as a means of reducing their electric bills directly, without making reference to the overall benefits of the smart grid of the future. Although a limited amount of energy saving (typically 2-5%, cf. Lewis et al.,2012) has been observed in many cases, the response is not uniform. Furthermore, the risk is that inflexible consumers will actually increase their energy bills under dynamic pricing conditions. The resultant potential credibility gap between utilities and consumers potentially raises the costs of further innovation and ultimately may take a concerted public-relations effort to overcome. One lesson is that overpromising on the benefits of smart meters and the smart grid should be avoided and both the potential benefits and potential costs of any change in electricity policy should be clearly articulated to consumers (who ultimately bear most of the costs). Although an inconvenient political reality, most energy policy changes are associated with trade-offs. When implementing a new infrastructure (e. g. smart meters with generally useful gateways), communication towards the end users should concentrate on long term effects and potentials for the addition of more services that can meet various needs of comfort, control, etc. It is also recommended to stress the ‘common good’ dimension of the new infrastructure (needed as an element in the transition to a low-carbon, mostly renewable energy-based energy system) by addressing the end users as citizens whose active involvement is needed to make the energy transition a reality.					
Background	The barriers addressed by this recommendation are related to knowledge and information as well as lack of awareness about the concept ‘smart grid’ and its potential gains.					
Comments	The Advisory Board supports this recommendation, but stresses that it has to be accompanied by short term motivation: “The long-term battle must be won in the short-time stimulus or the ship won’t take off.”					

Translate information on smart grid technologies and applications so a broad variety of citizens can understand it						
Target						
			EC legislation	x	associations of energy industry	
			EC level research programmes	x	associations of ICT industry	
		x	national policy makers	x	associations of and for consumers	
			national funding authorities		standardisation bodies	
			national regulatory bodies		curriculum developers	
		x	local authorities	x	suppliers to energy industry	
Details	Nowadays, energy saving has become a public issue in Europe through the implementation of new policy instruments (e.g. subsidies, regulations, energy-saving labels for appliances) that change the frame of energy so that energy saving tools and measures acquire new meanings. Similarly, the idea that smart grid technologies and					

	applications are needed to move towards an energy system predominantly based on renewable energy sources should gain a foothold in popular understanding. That requires that key information has to be related to the consumer ecosystem and that it has to be expressed in their language. Energy system actors (e.g. DSOs, suppliers, ESCOs, regulators) as well as other stakeholders (e.g. local associations and municipalities) must adapt the way and the content of their communication with customers and citizens, taking into account the diversity of consumer segments with different backgrounds and needs. The content of communication must be transformed into something more visual, tangible and understandable, showing exactly the benefits customers may experience (e.g. saved money, reduction of CO_2 emission) instead of a purely technical information. Taking into account that gaming approaches are common to most consumer segments, interactive and activating elements should be added to existing communication means. The first actual experience of households with new smart grid technologies will often be through the installation of a smart meter. The possibilities offered by the installation of smart meters are sometimes compared to what happened with mobile phones and the internet. However, in this case the benefits are related to electricity use, a low-interest topic in the first place, and the advantage of the new possibilities offered by the smart meter are not immediately apparent to end users. Therefore, it is necessary to create a real interest for electricity and demand response in the first place. Preferably, installation of a smart meter should be accompanied by the installation of a 'smart device' (e.g. in-home display, app on a smart phone, etc.) in order to communicate data about energy consumption on a meaningful level with the consumer. As mentioned, today we witness emergence of a new social norm: energy saving. The question is: how can demand response also become such a social norm and be embedded in new meanings attached to energy-using practices such as doing the laundry, washing dishes or drying clothes? Demand response can for instance be made a public issue where energy is publicly consumed, as in education, work places, apartment buildings or neighbourhoods. Office buildings also become increasingly important because of their likely future function as 'hubs' for electric vehicle charging. 'Living labs' (trials with ordinary people) with demand response should therefore be stimulated in these public places. Another way to extend demand response as the social norm is to use rewards for 'good behaviours' (e.g. incentives, but not necessarily financial). Rewards are not always the most effective way to convince consumers: loss aversion is often more powerful than gain expectation. Therefore it is also needed to reassure households that they will be better off compared to their previous situation. Community engagement can also be an effective tool, making use of social relations and networks. It may, however, require a higher initial investment and will not necessarily work in all localities. Community dynamics need to be already in place, as they cannot be created 'from scratch'. Local support from a combination of experts and peers can help consumers understand what to do, appreciate reasons for taking action (reasons that make sense to them personally) and provide the resources (time, space and money) necessary to take action.
Background	The barriers addressed by this recommendation are related to information, knowledge and social processes.
Comments	

Create trust in the energy system, its operators and the possibilities offered by new smart grid products and services.						
Target			EC legislation	x	associations of energy industry
			EC level research programmes	x	associations of ICT industry
		x	national policy makers	x	associations of and for consumers
		x	national funding authorities		standardisation bodies
			national regulatory bodies		curriculum developers
		x	local authorities		suppliers to energy industry
Details	For several reasons, trust is an important issue for the rollout of smart grid products and services: • The energy market is a typical market where consumers do not have a high level of trust for the supplying industry; • Most energy consumers have never experienced any kind of innovative service from their retailer or DSO; • Households or SMEs usually have no concept of what a smart grid related service actually is: they need to experience it to understand, trust and believe it. There are some indications however that this situation is (rapidly) changing. The growing installation of decentralised energy production units (local wind, PV) for instance leads to a situation where more and more energy customers are actively engaged with their energy consumption and production. This situation offers new opportunities for the 'traditional' utilities to establish new relations with energy customers based around new services or products (e.g. installation of batteries for PV owners, home-energy management systems, etc.) It is therefore important to touch as many consumers as possible with positive experience of smart grid products and services. As a rule of thumb, it is better to have a relatively large group of household or SME customers enjoying a somewhat positive experience than a tiny number experiencing an overwhelmingly positive experience. The more people are touched by (even slightly) positive experiences, the greater the 'snowballing effect' in the market and the more new customers will be motivated to also take up a smart grid product or service. Also, the creation of adequate market conditions (cf. Section on "Market Formation" in chap. 2.3) to enable third parties other than utilities to create add-on products and services for the 'smart energy' market (e.g. smart energy apps making use of the advanced communication infrastructure rollout), contributes to a large extent to this recommendation.				
Background	This recommendation addresses the barrier related to social process. Following this logic, E.ON in Sweden is rolling out over 100.000 feedback packs to its customers for free, in order to touch as many customers as possible. British Gas in Great Britain is offering an in-home display to every consumer that has a smart meter, amounting already to hundreds of thousands of customers.				
Comments	A member of the Advisory Board points to a more local than European lack of trust: "I do not foresee a decline of trust in a smart grid based energy system. However, I do agree that, at country-level, it is very important to have pilots and disseminate the multiple benefits through social media."				

Stress the non-monetary incentives to engage in the smart energy field					
Target			EC legislation	x	associations of energy industry
			EC level research programmes	x	associations of ICT industry
		x	national policy makers	x	associations of and for consumers
			national funding authorities		standardisation bodies

		national regulatory bodies		x	curriculum developers	
	x	local authorities			suppliers to energy industry	
Details	The risk of a low perceived financial benefit of smart grids by the customers can be a barrier to their successful implementation. In this sense, customers must be aware of all social benefits obtained by playing an active role in a Smart Grid context. As such, emotional incentives should be considered and addressed by electric energy agents, beyond the financial ones, when communicating with their customers. Examples are games and apps *(gamification)* where consumption is compared among friends and neighbourhoods, or the use of 'bonus points' or various reward systems beyond financial incentives. Variables such as the impact of increased consumption efficiency on the environment, may give customers the idea of control, competitiveness, independence and community feelings, sparking emotional drivers as basis for human action. New emerging practices such as peer-to-peer exchange or supply of energy take this into the field of new energy services (cf. chap. 2.3).					
Background	It will not be easy to convince communities and utilities since these intangible benefits may take many years and also a relevant investment. But like it has been done in the last years about recycling, we can predict that it may be possible to engage people to use these new services related to the smart grids even though they realize that financial impact is very low because they become able to perceive and value other non-financial benefits.					
Comments						

2.2 Recommendations related to "Regulation"

These recommendations should help to improve the legal and regulatory framework so it allows for the implementation of consumer engagement means and get them reimbursed by grid fees or tariffs.

Dealing with people often means to collect and store personal information. These recommendations should help to define a favourable framework that enforces correct use of data and builds trust.

Create and enforce smart grid standards.						
Target	x	EC legislation		x	associations of energy industry	
		EC level research programmes		x	associations of ICT industry	
	x	national policy makers			associations of and for consumers	
		national funding authorities		x	standardisation bodies	
	x	national regulatory bodies			curriculum developers	
		local authorities		x	suppliers to energy industry	
Details	The lack of standard-enforcement capability for crucial aspects of the smart grid (such as cybersecurity and interoperability) can pose a threat to potential investments in innovation by manufacturers and utilities alike. In fact, in a survey of project managers of smart-grid projects in Europe, the lack of interoperability between system elements was the most common obstacle reported (Giordano et al., 2013). The prospect of assets rendered obsolete due to a changed landscape of standards can significantly limit investment and risk-taking, which are both necessary ingredients of innovation. As the vision for the smart grid continues to be refined through a deepened understanding of the available technologies and collected data, so the framework of standards and regulations evolves to accommodate development and nurture innovation as well. Standardization is not limited to the definition of communication protocols and plugs. Above all, a common understanding of the overall system architecture is necessary. It starts from using a common terminology with clearly defined semantics. To that end, it is highly recommended to foster the architecture and terminology as defined by EC					

	mandate M / 490.
Background	The barriers addressed by this recommendation are related to ease-of-use and comfort of smart grid applications.
Comments	

Establish an overall data infrastructure that allows for a wide set of consumer engagement means and at the same time does not create the anxiety of abusing personal data.

Target

x	EC legislation	x	associations of energy industry
	EC level research programmes	x	associations of ICT industry
x	national policy makers	x	associations of and for consumers
	national funding authorities	x	standardisation bodies
x	national regulatory bodies		curriculum developers
	local authorities	x	suppliers to energy industry

Details

Many service and business scenarios require access to household consumption data. There is trade-off involved between all the potential benefits (in the form of potential business cases) of smart-grid data and the privacy concerns that come with them.

In general, a balance needs to be struck between developing new services and products based on smart grid data (e.g. energy saving tips, smart home applications, etc.) and respecting fundamental rights to privacy. Policy solutions can/need to be developed in the following domains:

- electricity database auditing procedures (just like financial documents are audited);
- ways to anonymize and aggregate data (without compromising their use);
- encryption-technology standards.

Lessons can be drawn from existing privacy frameworks aimed at protecting consumer financial data or online browsing data. For example, the privacy policy of a major Internet search company explains what information is collected, how the information is collected, and how the information is used. There is a brief explanation of the technologies used in collecting Internet data (e.g., device information, log information, location information, local storage, cookies). Transparency also involves the ability to review information tied to one's account and control how the information is shared. If we were to apply such principles to the energy industry, utilities would dedicate specific effort into educating customers about information collected from disaggregation of smart-grid data.

In general, to protect the interests of the customers, the following overarching principles of data management should be honoured – and clearly stated towards customers:

- Consumers have unrestricted access to their data, past and present. The retrieval of data must then be free, and past data always available even when switching (i.e. changing of supplier).
- Consumers have an unlimited right to use and exchange their raw consumption data, namely independently of any secondary treatment or transformation by a software.
- Grid operators have the right to use data as far as it is needed to optimally manage the grid. In most cases such data can be anonymous or aggregated.
- Consumers can give their data under license (or sell it) to a third party (e.g. an ESCO, aggregator or marketing institution).

Since adequate handling of consumer and grid data is key to a secure and cost effective management of the system, regulatory bodies should regulate and incentivise the creation of an overall infrastructure where data can be sourced, validated, stored, protected, processed and provided to different parties, with explicit permission by customers. In addition, the regulator should shape the market architecture defining who should manage the data infrastructure and which kind of systems and interfaces are needed.

Such a new data infrastructure should

	• combine smart energy meter data with meter data for water, gas, heat, etc. • be implemented in a resilient way in order to not lose control over the energy grid when loosing data • be operated in a non-discriminating way. In general terms, such a data infrastructure should be operated by a regulated and neutral stakeholder with experience of data management, and able to create synergies between meter operation and data collection with data management. Through this infrastructure, data could be provided for free to the customers as owners of the data (e. g. in the form of basic data such as hourly-based load diagrams), e.g. together with apps from third party service providers that may increase consumers' engagement. In addition, consumption data may also be provided to other market parties (whose requests are increasing). Of course, customer's personal data can only be provided to other market agents with an explicit authorization by the customers. The Data Access Manager (DAM) architecture as discussed by advanced system architects may be a solution. One candidate for the implementation and operation of a common data infrastructure could be the group of DSOs since it would not need significant regulatory changes, would bring increased cost and process efficiency and would reduce the complexity for consumers' usage.
Background	The barrier addressed by this recommendation mainly relates to privacy concerns. There are some barriers, from the standpoint of regulation, related to the implementation of the best data management solution. On the one hand, the "best architecture" to use is still under discussion without a single conclusion (despite the preference of the model referred above). On the other hand, the deployment of this infrastructure requires considerable investments and may generate some extra operational costs that should be recognized by the regulator. The other barrier is the trust and perception by customers that their data is "in good hands" and that is not used for other purposes nor provided to other parties without their consent. To overcome this situation, regulators should choose neutral and capable entities to perform data management activities and those entities should be completely transparent in order to create a sense of security for the customer.
Comments	It will be key to combine the smart energy measurements with smart gas, heating, and/or water measurements. This allows to develop integrated 'smart resources management' solutions for households or SMEs, who after all might be interested in the overall environmental or financial impact of their resource use (instead of singling out electricity use only).

Ensure market designs facilitating a balanced distribution of costs and benefits by conducting regulatory impact studies.						
Target		x	EC legislation		associations of energy industry	
			EC level research programmes		associations of ICT industry	
		x	national policy makers		associations of and for consumers	
			national funding authorities		standardisation bodies	
		x	national regulatory bodies		curriculum developers	
			local authorities		suppliers to energy industry	
Details	The overall discussion on the distribution of costs and benefits of smart grids is complex because we are in presence of a split-incentive problem. The different energy market actors favour the deployment of a smart grid for various reasons. Ideally, the costs of such a system should be distributed according to the expected benefits of each actor. But such benefits are almost impossible to evaluate with sufficient precision. For instance, one of the major points of disagreement is about the benefits that smart meters can bring to the households. In particular, no clear scientific agreement can be found on the					

	expected energy savings that can be achieved with smart meters in an average household, and as our S3C research has amply shown, an 'average household' does not exist at all. More generally, estimating the overall cost of the smart grid and allocating them amongst the actors is a difficult exercise for two reasons: the costs are very dependent on the functionalities to be implemented and the view on how the system will evolve; and the benefits are shared by all actors and are also dependent on these functionalities. In order to get relevant cost-benefit-scenarios, studies should include and differentiate between socialized and individual cost - with the individual part including products offered in a competitive market. Evaluation of the distributional effects of smart-grid regulatory initiatives should therefore be a key feature of future regulatory initiatives. This deals with how the benefits and costs of specific smart-grid rollout initiatives should be allocated among incumbent firms, new investors, and a diverse customer base. Future regulatory designs should recognize that different groups of individuals and firms may face new and different incentives and should attempt to realize a fair distribution of costs and benefits for all stakeholders involved, especially by preventing that costs are 'socialized' to the large but in political terms relatively unorganized household customer base. To ultimately assess the benefits and the necessary frameworks for the implementation of a smart grid infrastructure and related services, cost-benefit-analyses are indispensable. To come to comparable results and in the end to a feasible market framework in the European Energy Union, a common approach should be taken, such as the cost-benefit-exercise as developed and implemented in ISGAN Annex 3.
Background	The barriers addressed by this recommendation are related to finance, investment costs and increased energy bill.
Comments	There are some concerns voiced by ADB members that conducting regulatory impact studies might further slow down the regulatory process mainly because time from academic and practical insight to regulatory implementation takes (too) long. To that end, another recommendation would be to speed up the processes towards new legal and regulatory frameworks.

Establish a regulatory framework to support the introduction of cost-reflective dynamic tariffs .					
Target					
	x	EC legislation		associations of energy industry
		EC level research programmes		associations of ICT industry
	x	national policy makers		associations of and for consumers
		national funding authorities		standardisation bodies
	x	national regulatory bodies		curriculum developers
		local authorities		suppliers to energy industry
Details	As described by S3C in detail, various types of dynamic tariffs can meet the needs of DSO's, ESCo's and consumers as well. National regulatory bodies should be open for new cost-reflective tariff schemes that use variable pricing (hourly basis or other short-term) to reflect the variations in the prices of wholesale market (utility's cost of generating and/or purchasing electricity at the wholesale) as well as (local) needs for protecting grids from congestion. Regulation should require a thorough discussion of the potential positive effects of such a tariff in relation to the efforts of its implementation.				
Background	In the consortium as well as in the Advisory Board, this recommendation has been discussed as quite controversial: • Overall prices of electricity are so low that a dynamic tariff in absolute numbers can hardly pay enough for users changing their behaviour. • Price elasticity of households is very limited, so they have no interest in dynamic tariffs.				

	• Costs of taxation and general costs (network etc.) are about 50% in the electricity tariff. Dynamic pricing will therefore not have any real impact on the overall tariff (since it affects only 50% of the overall tariff), and therefore on the behaviour of households. • Promoting general energy savings can be considered to be more important for households (rather than providing flexibility). Following these arguments, regulatory frameworks to ease implementation of dynamic tariffs would not be that important.
Comments	Implementation of dynamic tariffs together with the requirement to then measure and monitor consumption on a quarter or full hour rate solves another problem of the electricity system: standard load profiles (which today do not anymore allow for adequate prediction of grid situations) can be replaced by real data and way more accurate prediction means.

2.3 Recommendations related to "Market Formation"

This section discusses barriers to entrepreneurship and how public policy may influence development of new business opportunities.

Open up the energy market to new players and their innovative products.					
Target					
		EC legislation		x	associations of energy industry
		EC level research programmes		x	associations of ICT industry
	x	national policy makers		x	associations of and for consumers
		national funding authorities			standardisation bodies
		national regulatory bodies			curriculum developers
	x	local authorities			suppliers to energy industry
Details	The electric sector is evolving rapidly and by consequence, consumers are to be involved as customers, prosumers or citizens, which provides a suitable environment for the emergence of new players with new products and services to fit their needs. Consequently, it is vital that a regulator may recognize and incentivize incumbent players to give conditions to facilitate the integration of new players. The establishment and scope of the activities of each party and their relationship must be well defined by the regulator but should not block the emergence of a new market with new services and new market participants. To support this evolution, it is necessary that existing market players newly interpret their roles and are allowed to do so by the regulatory bodies. In addition, regulators as well as existing market players should be open to integrate new market partners. The regulators must shape the emergence of a robust, transparent and equitable market design where new players (e.g. aggregators, ESCOs) can enter and provide their services and products to customers, ensuring at the same time principles like network efficiency and security. Consequently, it is vital that the regulator may recognize and incentivize incumbent players when providing conditions to facilitate the integration of new players. The regulator should well define the establishment and scope of the activities of each party and their relationship but should not block the emergence of this new market. In general terms, it seems to be a fruitful avenue to explore the potential of combining the rollout of the advanced metering infrastructure (AMI), which will be needed anyway for managing the smart grid (including residential active demand), with business opportunities for non-energy enterprises in the field of 'big data' and internet e-commerce. At the end, it will not be the meter as such that allows for new products and services. It will mostly be the meter interface (gateway) that allows for data transmission back and forth between end users and service providers. There are, of course, significant privacy issues involved in using consumer data – these are covered in Section 2.2 "Regulation".				

	Developing new products and services calls for changes in the market places as well. There is a need to enhance the existing markets to trade with flexibilities, i. e. with generation and consumption adaptation capacities.
Background	Business models of active demand based on selling flexibility offered by residential customers to the electricity market do not seem to be viable at present. The financial gains to be made by using dynamic tariffs such as time-of-use tariffs, critical peak pricing or real-time pricing at present are simply too small to provide a good incentive for residential customers to participate in such innovative tariff schemes. This situation could, however, change with the widespread introduction of new electric appliances with the potential of offering more flexibility to the market, such as battery-electric vehicles, heat pumps or electric storage devices. This is all part of the so called "new energy deal" and requires a new market design. There is a whole range of business opportunities tied to using AMI data which currently the energy utilities do not seem to be fully ready to capitalize on. For instance, having disaggregated energy consumption data at the level of individual appliances would allow for a cheaper and more automated way of conducting energy audits. Instead of having to organize individual house visits, a software program can examine the smart-meter data, and this could be done for any household at any time. Most importantly, these measures would be tailored for the specific household rather than general recommendations for the average household (Guo et al., 2015). For utilities, a key benefit would be better interaction and communication with their customers. Instead of facing a homogenous market, utilities armed with disaggregated data could segment the market by demand characteristics. Learning more about how their customers use electricity helps utilities identify customers and customer groups for marketing purposes (Guo et al., 2015). Regulators should recognize the role of DSOs as market facilitator (as a "neutral bridge" between players, devices and customers) and consequently incentivize some of these fundamental investments (e.g. implementation of new devices that can favour communication between existing markets and new ones). As consequence of this support by the regulator, at an early stage, a new environment may be created with the emergence of new start-ups and consequent investment in R&D derived from their confidence that the market will absorb some of their innovative products. Here again, the DSOs' role is fundamental in controlling the network operation and implementing safety measures to avoid "gaming" by market players. The incentives granted by the regulator to promote the investment in R&D may be an obstacle. Demonstration of the benefits of these investments are key to convince national authorities.
Comments	Members of the Advisory Board pointed to the fact that it is very difficult to balance between "fair regulation in detail" and "open regulation, which does not block new business models". In general terms, regulation should be rather generic (competition rules) than go into network and device design.

Clarify settlement rules between suppliers and aggregators						
Target			EC legislation			associations of energy industry
			EC level research programmes			associations of ICT industry
		x	national policy makers			associations of and for consumers
			national funding authorities			standardisation bodies
		x	national regulatory bodies			curriculum developers
			local authorities			suppliers to energy industry
Details	Creating a level playing field between providers (i.e. independent aggregators and costumer's retailer) is a key requirement in improving the competitiveness of demand response services offered to consumers. In most EU countries, the current regulation					

	does not allow independent demand response aggregators to compete effectively, as the interactions require bilateral agreements between independent aggregators and balance responsible partners/retailers, effectively allowing the latter to block entry to third parties. To better address demand side response, alternative market models may be considered. On the one hand side, a simpler approach could be put in place only through suppliers, offering demand response services to their customers and acting as demand response aggregators. On the other hand side, market models with other players, such as aggregators, are being considered in some countries. In this sense, regulators should establish a clear market model that clarifies roles, responsibilities and interactions between suppliers and aggregators regarding contractual and operational relations, such as: • Rules of compensation related to the activation of a flexibility, regarding the adjustments to be made to existing contracts (e.g. data that needs to be exchanged); • Balance responsibility requirements (e.g. necessity of a different balance responsibility partner for aggregators) • Rules to avoid free riding and market distortions.
Background	Regulation must take into account costs and benefits related to a higher complexity of this market model (e.g. includes more players and ICTs) allowing on the one hand the "market formation" but on the other hand assessing in which extend benefits for the whole system are higher than costs.
Comments	

Provide financial support and incentives for the participation of end users in smart grid programs					
Target	x	EC legislation		associations of energy industry	
		EC level research programmes		associations of ICT industry	
	x	national policy makers		associations of and for consumers	
		national funding authorities		standardisation bodies	
	x	national regulatory bodies		curriculum developers	
	x	local authorities		suppliers to energy industry	
Details	In a similar way as there was a financial support for the market uptake of RES, which was sourced from public funds, the participation of end users in smart grid programmes should be supported as well. The financial support for RES resulted in a fast deployment of distributed renewable energy sources, which helped the EU to reach important environmental goals. Since one of the foreseen functions of demand response is to contribute to a cost efficient distribution grid management with increasing penetration of distributed energy sources – which benefits all end users connected to this grid as a 'public good' – following a similar logic, the participation of end users in smart grid programmes could receive adequate financial treatment, too. It is not necessary to provide "direct subsidies" in monetary terms only. For various consumer groups free access to knowledge or simple software gadgets could be attractive.				
Background	This recommendation addresses the barrier of insufficient financial incentives. Results of the smart grid pilots investigated in S3C have shown that the financial incentives of demand response are too small to really motivate end users for the time being. Additional funding (e.g. subsidies) is one of the means to alleviate this barrier.				
Comments	The recommendation is inspired also by the Energy Efficiency Directive 2012/27/EU which gives "*Demand response is an important instrument for improving energy*				

	efficiency …" and " *… provides a mechanism to reduce or shift consumption, resulting in energy savings …*"

2.4 Recommendations related to "Research"

Broaden the scope of smart grid research to integrated smart solutions (smart cities, smart homes, smart living)						
Target						
			EC legislation	x	associations of energy industry	
		x	EC level research programmes	x	associations of ICT industry	
			national policy makers	x	associations of and for consumers	
		x	national funding authorities		standardisation bodies	
			national regulatory bodies	x	curriculum developers	
			local authorities	x	suppliers to energy industry	
Details	The smart grid is a very abstract concept that focuses on electricity – a 'low-interest topic' from the point of view of the general public. In fact, customers in Europe and elsewhere are currently either completely unaware of the new possibilities a smart grid has to offer or they sometimes even perceive active demand as a loss of comfort or even as an attack on their privacy. Coupling the topic with other thematic areas that are known to raise more interest and appear less abstract is a promising strategy to overcome obstacles such as false perceptions or no perceptions at all. Therefore, it is crucial to explain the interconnectedness between topics such as smart grids, smart cities, smart mobility and sustainable lifestyles to 'unaware' end users. The roll-out of smart grid infrastructure can be connected to the introduction and development of holistic smart city concepts. Thereby, the smart grid infrastructure can help to introduce different services based on IT technologies, such as smart mobility, smart data based public services. This can lead to a decrease of the infrastructure costs for the smart grid as such. Apps that are currently only trialled in smart grids projects for the sake of manual or automated energy management could be used for several other smart city functionalities that offer more added value to the customers. Furthermore, the merging of smart grid technology and known and trusted home automation functionalities in an overall smart home approach could boost the acceptance and market relevance of smart grids technologies. Different smart home functionalities can be realized by the same hardware and software application, thereby decreasing the overall costs for energy management systems and increasing the benefit for the customers. The further added value might increase the customers' interest in the newly developed solutions and offer them the added value that often appears to be missing in current smart grids business cases. In fact, it is important to capitalize on the comfort-increase factor with respect to energy management to frame the smart grid service within the concept of a smart home. In a more practical sense this broadening of the scope leads to the concept of horizontal hardware and software platforms as described in chap. 2.5					
Background	This recommendation addresses the barriers related to lack of information about the smart grid concept and comfort.					
Comments						

Foster participation of social sciences in energy projects.						
Target						
			EC legislation	x	associations of energy industry	
		x	EC level research programmes	x	associations of ICT industry	
			national policy makers	x	associations of and for consumers	
		x	national funding authorities		standardisation bodies	
			national regulatory bodies	x	curriculum developers	

		x	local authorities		x	suppliers to energy industry		
Details	To understand how end users behave in smart grid programmes, an interdisciplinary research approach is needed that acknowledges the interaction between households/SMEs and their social environment, and the technological context of the smart grid. Such integrated socio-technical research increases the understanding of social and technical aspects being interwoven and mutually influencing in smart grid programmes. The S3C guidelines and tools can serve as a starting point to assess the benefits of taking into account social aspects and to take first steps. When we talk about customers, it is important to have in mind that there are many variables to consider and that there are many different segments that must be addressed differently. So it is essential to identify and target those customers who are more likely to anticipate on active demand schemes. For instance, various target groups do not respond linearly to financial incentives and are more open to attitudinal and emotional incentives. In this sense, it is essential that utilities work with universities and other institutes (e.g. related to social sciences) that can easily assess the different needs of customers in different time frames. This kind of partnership is the key to assess whether the investments will, or will not generate the expected benefits. Besides, it is important to maintain these partnerships across time because customers will evolve and energy companies will need to continuously adjust some aspects. Such an interdisciplinary research approach is up to date focusing on academic – company – citizens research partnership. “Energy” is a good field for the ‘citizen science’ approach, where citizens become an integral part of the research set-up by observing and analysing their energy-related behavior. Such projects could unveil the most successful incentives to motivate people to take up ‘smart’ energy behaviours. The recommendation could be implemented by defining respective requirements in the operational funding programmes (e.g. H2020) and calls (as it has been implemented by ERA-Net Smart Grids Plus, which preferably accepts projects that tackle all three layers: technology, market and adoption). As a first step, call documents could refer to the findings, guidelines and tools of the S3C project (and its “sister project” ADVANCED) to make project designers aware of the needs to consider social aspects.							
Background	Definitions of ‘the technical’ and ‘the social’ are shaped in a dynamic, historical process of co-development. In order to achieve lasting changes (both in technological infrastructure and in end-user behaviour), a socio-technical approach addresses both the individual and the social levels of change. Thus, a socio-technical research approach takes into account that the potential to change a behavioural pattern not only lies with individual households or SMEs. If others do not learn to change as well, and if the change is not accompanied by changes in culturally shared norms and values, and supported by adequate technologies, policies, regulations and infrastructures, then the individual household or SME will soon revert to his/her ‘old’ behaviour because the context is not supportive of or may even impede the ‘new’ behaviour. To overcome this situation of a potential fall back to ‘old’ behaviour, it is important that EC or national regulator recommends the realization of sociologic studies when new technologies that were created for customers usage are introduced.							
Comments	There is a good reason to actively involve customers and consumers in R&D projects: While research methodology is more or less common in all European cultures, it is important to understand that cultural differences govern the use of energy. In different countries consumers perceive the role of energy differently (e.g. energy for heating and cooling is very different in southern countries than in central EU-states). Comment from a member of the Advisory Board: First, it “*is a question of the perspective that is taken. Smart grids are only a means and not an end. Therefore, the question needs to be what kind of societal transformations or transitions do we want to achieve, what are the goals of such a transformation and in which way can smart grids support it? It is not that smart grids need a cultural change, but that a truly*							

	sustainable development needs a cultural change that can be supported by new technologies, which smart grids are a part of.”

Foster research and development on end-user engagement in smart grids through clear priorities and increased collaboration	
Target	EC legislation x EC level research programmes national policy makers x national funding authorities national regulatory bodies local authorities associations of energy industry associations of ICT industry associations of and for consumers standardisation bodies x curriculum developers x suppliers to energy industry
Details	To better coordinate research efforts and to achieve greater efficiency in financing while also promoting knowledge transfer and ensuring the quality of research, a comprehensive thematic plan of behavioural research in smart grids is required. This overarching thematic research plan should have clear long-term priorities and could be developed on a national as well as EU level. This could be achieved through enhanced collaboration between different stakeholders in the field of smart grids, including research funding agencies. End users, at home for example, have to deal, engage and decide on different commodities. R&D on end users should adopt a holistic perspective. This could mean combining criteria, perceptions and towards integrated co-management of resources (including e.g. water) and sustainable development.
Background	The barriers addressed by this recommendation are related to knowledge and information, as increased knowledge about energy and behaviour will benefit the end users through better designed smart grid programmes.
Comments	The EC's attempts to bring together H2020 projects in various working groups, projects such as GRID Plus Storage or the ERA-Net Smart Grids Plus approach to build a knowledge community should be widely published and used to join forces.

Combine quantitative and qualitative research in new smart grid pilots or rollouts	
Target	EC legislation EC level research programmes national policy makers national funding authorities national regulatory bodies local authorities associations of energy industry associations of ICT industry associations of and for consumers standardisation bodies x curriculum developers suppliers to energy industry
Details	Quantitative data (e.g. amount of flexibility offered by customers in demand response programmes, on economic costs and benefits, etc.) are of paramount importance in order to support an efficient and effective rollout of the future smart grid. However, purely quantitative data will not allow us to obtain an in-depth understanding of the 'storyline' of why and how particular households or SMEs choose (or choose not) to participate in a particular smart grid pilot or rollout. Qualitative research methods (e.g. in-depth interviews, focus groups or contextual inquiries) provide a deeper understanding of the considerations and domestic negotiations that take place continuously – and often unconsciously – within households. Qualitative data and research are also of vital importance to supplement the quantitative data. The importance of a good interaction between qualitative and quantitative research can be appreciated as follows. The problem with a quantitative analysis based purely on observational data (data not generated by random assignment of presumed causal factors), is that mere patterns or associations are not enough to allow us to draw inferences about "what causes what". The standard approach in statistical work in the

	social sciences is therefore to accompany the presentation of associations (often in the form of regression results) with arguments about i) why the reader should believe that the variation in an independent variable could cause variation in the dependent variable; and ii) why the reader should believe that the association observed in the data is not due to the independent variable happening to vary with some other, actually causal factor. The latter is usually done by adding "control" variables to the regression model, and arguing that one has not omitted important factors that are correlated with the independent variables of interest. The arguments for (i) and (ii) actually amount to a sort of *story* the researcher tells about the associations observed in the regression results. To some extent these stories can be evaluated as to whether they are deductively valid, that is, whether the conclusions do indeed follow from the premises, and whether the arguments are consistent. For example, it may be that the argument for why one independent variable matters contradicts the argument made on behalf of some other variable. Or it may be that an argument for a particular independent variable is internally inconsistent, confused, or does not follow from the premises on closer inspection. Qualitative research on argumentation patterns can help in building plausible and consistent explanations (for an example on how to apply such analysis in the context of smart grid pilots, see the S3C Deliverable 3.4, available the project website www.s3c-project.eu). Moreover, this recommendation extends to the evidence base for regulatory intervention. If we take the idea about the importance of qualitative evaluations of the wellbeing of 'smart' consumers seriously (that is, we do not presume that their wellbeing derives solely from quantitative results such as the amount of energy or money saved), we also need policies that consider qualities without being obsessed by quantitative evaluations and economic reductionism.
Background	This recommendation potentially addresses all barriers, as it will lead to a better practical understanding of what drives end user behaviour in smart grid programmes.
Comments	

Foster research on less motivated or involved end users, beyond a focus on 'early adaptors' or 'technology enthusiasts'.

Target

	EC legislation	x	associations of energy industry
x	EC level research programmes	x	associations of ICT industry
	national policy makers	x	associations of and for consumers
x	national funding authorities		standardisation bodies
	national regulatory bodies		curriculum developers
	local authorities		suppliers to energy industry

Details

Regarding the upscaling and replication of smart grids, there is a need to go beyond the early adopters that often participate in current research and living labs. Insight in the needs of the early and late majority (e.g. low income groups, traditional values, etc.) is still largely uncharted territory.

Many smart grid pilot programs only include households that registered voluntarily because they were interested in the topic at hand – a fact that introduces selection bias. The problem with selection bias is that only those who anticipate that the benefit from treatment will be greater than the cost of treatment will participate in a particular pilot. For instance, we can foresee that the people who stand to gain the most from real-time pricing will sign up and exhibit higher levels of demand response. In this case, it would be incorrect to assume that the effects measured in pilot studies can simply be extrapolated to the entire population across heterogeneous consumers.

A further critique of the pilot experiments conducted to date, is that few pilot

	programmes analyse the distribution of responses or impacts on electricity bills across customers. There is evidence that most of the reduction in demand comes from a relatively concentrated number of consumers, but we have little understanding of who these customers are and how persistent their behaviour is over time (Breukers and Mourik, 2013). There is a danger that, in the long-run, user responses could be more moderate if older habits resurface after the novelty of the pilot program wears off. Some research should be implemented on how to motivate and train installer so they do not only know the technology but can and also want to "sell" the options.
Background	The recommendation addresses all the barriers, specifically as seen from the perspective of less-involved consumers.
Comments	

Develop and implement common and standardized quality criteria to ensure representativeness and comparability of end-user engagement research in smart grid projects or rollouts.				
Target				
		EC legislation	x	associations of energy industry
	x	EC level research programmes	x	associations of ICT industry
		national policy makers		associations of and for consumers
	x	national funding authorities		standardisation bodies
		national regulatory bodies		curriculum developers
		local authorities		suppliers to energy industry
Details	Just as technological standardisation and ensuring interoperability of different smart grid components are key to developing market-ready smart grid products, standardisation of processes and research designs in the end-user activation and engagement will become the necessary prerequisite to gain scalable and replicable insights into end-user behaviour. Comparable insights are crucially needed to develop an acceptance and, thus, demand for the new technologies on the European markets. Since i) nearly every demonstration project devises its own research formats based on different baseline calculations, ii) nearly all of them work with unrepresentative test samples, iii) the incentive combination and communication strategies connected with dynamic pricing schemes are extremely diverse and iv) many factors influencing end-user behaviour remain unknown, the results of smart grids projects can hardly be compared at this point. Up to date, similarities and differences can be pointed out and different hypotheses can be drawn. However, in order to gain acceptance for a potential smart meter and smart technology rollout, more research is needed that should ideally be based on a common research approach. It should be mainly up to industry associations and funding authorities to join and define common sets of measures, indicators and evaluation processes. Academia should be involved to formulate clear quality statements with academic relevance.				
Background	Common evaluation criteria, categorization, profiling and benchmarking are also important to share knowledge originating from projects.			
Comments				

2.5 Recommendations related to "Resource Mobilization"

The rollout of AD programs crucially depends on having the right kind of infrastructure in place (e.g. smart meters, in-home displays, home energy management systems, etc.), but also human resources (e.g. skills). The recommendations under this heading are aimed at mobilizing these resources.

Allow for end-user engagement means to be accounted for as grid investments in the calculation of distribution grid fees.					
Target	x	EC legislation		associations of energy industry	
		EC level research programmes		associations of ICT industry	
	x	national policy makers		associations of and for consumers	
		national funding authorities		standardisation bodies	
	x	national regulatory bodies		curriculum developers	
		local authorities		suppliers to energy industry	
Details	Allowing a regulated industry (such as DSOs) to diversify into new markets could enhance operational and help to achieve cost savings. Expanding into a related line of business can increase the utility's incentive to innovate and can lead to higher gains in consumer welfare over time. On this account, the entry of regulated utilities into the market for smart grid products and services represents a new business opportunity. A major barrier to this recommendation relates to the fact that currently the allowed investments by DSOs are based on an extrapolation of historic data (e.g. using standard load profiles for different types of households/SMEs and predictions on the additional amount of households/SMEs that need to be connected to the grid). Regulators and utilities should thus consider moving to a new investment decision model based on more dynamic future planning methods, with regulators developing utility-specific regulations and policies that allow utilities to move into new markets without undue regulatory burden or the risk of generation of monopoly rents.				
Background					
Comments					

Acknowledge potential risks of increasing costs in the transition phase to a smart energy world					
Target	x	EC legislation	x	associations of energy industry	
	x	EC level research programmes	x	associations of ICT industry	
	x	national policy makers		associations of and for consumers	
		national funding authorities		standardisation bodies	
	x	national regulatory bodies		curriculum developers	
		local authorities		suppliers to energy industry	
Details	In order to quantify benefits, costs and risks, it is important that regulators assess the impact of each type of investment concerning the development of smart grids. Cost benefit and risk profile analyses should be performed by regulators giving them a real confidence about benefits and consequently about incentives they can implement to incentivize market development. This assessment should be done not only over the network (e.g. higher operational efficiency) but also over customers (e.g. necessity of installers of SM with engagement skills that may have higher costs but may foster the engagement of customers with active demand response actions). With this approach, regulators should be confident about high costs in this initial stage of development because in the long term this will be translated into lower costs to the overall system. Additionally, the European Commission may also promote, along regulators of its member states, best practices from different countries with different degrees of deployment.				
Background	Smart grids are not only composed by smart meters or by a large number of other systems and devices, but also by human resources with different skills (not only to build it but also to ensure its efficient operation over time.) The creation of such an infrastructure will require considerable investments and some				

	new operational costs mainly in the short term (e.g. more skilled human resources). DSO and other agents need to demonstrate to regulators how important it is to recognize these costs and how they will ensure a positive NPV for the electricity system. A possible action is to increase the involvement of regulators in forums where the costs and benefits of the several technologies are discussed and in which usually DSOs, suppliers and ICT manufacturers are present. Real demonstration and quantification, through small pilots, about the costs and benefits of each kind of investment may be also be key in order for national authorities to consider them as innovative and regulate the existence of incentives to their deployment. Another barrier that may have a negative impact on active demand response is the cost of overall systems needed to implement some types of demand side management actions (e.g. through aggregators with considerable ICT costs from several market players). This could be mitigated through the implementation of other simpler types of demand response at an early stage, such as dynamic tariffs that are not so complex and could be as effective as other more complex and expensive systems.
Comments	

Shift the regulatory focus in distribution grid investment from cost of investment to net benefit of investment.

Target

x	EC legislation		associations of energy industry
	EC level research programmes		associations of ICT industry
x	national policy makers		associations of and for consumers
	national funding authorities		standardisation bodies
x	national regulatory bodies		curriculum developers
	local authorities		suppliers to energy industry

Details

Traditional rate-of-return regulation has focused on the allowance or disallowance of capital costs in the rate base of utilities, primarily as a check on the incentives of a (vertically integrated) utility to oversupply capacity when investment costs are completely passed through to customers. In a system where the objective was to reliably serve electric customers at the lowest cost, the focus on allowable costs is understandable.

Regulators and policy makers should, however, be aware that a system that is changing because of grid modernization will require additional, costly investments that will likely be passed through to customers in the short run but should benefit them – at least collectively – in the long run. Furthermore, in a complicated environment in which new technologies are developing and multiple regulatory objectives exist (e.g., the mandatory incorporation of distributed renewable energy sources), incentives may be created to adopt systems that do not directly benefit customers in terms of lower electric bills, but rather in terms of other types of benefits (e.g. reduced greenhouse gases, increased energy security). That is, investments related to the smart grid, as currently envisioned, are not designed just to replace legacy capital but rather to create a joint electricity and communication system that provides for future opportunities to increase system efficiency subject to additional regulatory goals (e.g. incorporation of renewable technologies and distributed generation).

Public utility commissions should thus focus on the overall social net benefits (consumer and producer surplus, including any external benefits and costs) of an investment plan in rate cases rather than on the minimization of infrastructure costs. Because these technologies are expected to enable the reduction of a variety of negative externalities from the existing system and generate positive learning-by-doing and other positive externalities, all of these benefits and costs should be taken into consideration when approving rates. Examples include monetizing avoided costs from

	improved reliability, emission savings from integrating renewable energy sources and fewer vehicle-miles travelled for repairs. It is crucial that the net-benefit model is sensible and well-considered in the sense that it takes into account the interests of the different stakeholders. In short, the desirability of smart-grid investments should take into account a complete accounting of the expected benefits and costs of the technology, above and beyond the impact on customers' electric bills. If the total social benefits exceed total social costs, and the costs and benefits are balanced over all stakeholders involved, then the regulator should adopt policies that incentivize the adoption of those technologies, keeping in mind that the utility has an incentive to invest only if expected profitability increases. For some investments for which cost savings are not immediately forthcoming, this may result in higher short-term retail electricity rates.
Background	This recommendation is aimed to ensure that the necessary infrastructure for end user engagement in smart grids is put in place.
Comments	

Develop common standards of automation and data communication						
Target						
			EC legislation		x	associations of energy industry
		x	EC level research programmes		x	associations of ICT industry
			national policy makers		x	associations of and for consumers
		x	national funding authorities			standardisation bodies
		x	national regulatory bodies			curriculum developers
			local authorities		x	suppliers to energy industry
Details	User acceptance of technologies highly depends on the ease of use, compatibility with existing devices and exchangeability. With the emergence of several technologies in the fields of smart grids and smart homes (including electric mobility), it is essential that the European Commission identifies and legislates for the establishment of technical standards, interoperable communications and data protocols in order to increase efficiency, data protection and security of operations between all stakeholders (utilities, ICT providers, other market players). These standards should be extended as far as possible, respecting specific situations, to all EU members paving the way for a broader market competition of ICT providers and correspondent costs reduction.					
Background						

Provide a wide spread set of horizontal hardware and software platforms to foster development of innovative services (mainly by SMEs)						
Target						
			EC legislation		x	associations of energy industry
		x	EC level research programmes		x	associations of ICT industry
			national policy makers			associations of and for consumers
		x	national funding authorities		x	standardisation bodies
		x	national regulatory bodies		x	curriculum developers
			local authorities		x	suppliers to energy industry
Details	The way to a new energy age will have to be paved with new services that go way beyond supplying energy. Many such services will be implemented using the means of ICT. They must rely on existing hardware and software platforms to become affordable for a broad public. Such platforms (sometimes called the "energy information system" in contrast to the "energy system") must be implemented and operated in a non-restrictive way. Only then a big variety of services – optimally meeting the needs of private and business end users - will be provided by an increasing number of (small and medium sized) companies.					

	In the framework of the EC's Future Internet Public Private Partnership (FI PPP) an extremely comprehensive set of software packages (FIWARE) has been developed that serves multiple "usage areas" such as health, mobility, infrastructure, energy etc. With the projects Finseny and FINESCE, requirements for the energy sector have been identified. Generic and Domain Specific Enablers have been developed and tested and are now available on an open source base for further use (e. g. via the FEN consortium). Innovative training and cooperation means (such as "hackatons") would even further grow the capabilities of software engineers and business developers.
Background	
Comments	

Implement means to convey learnings and tools of S3C (and other similar projects) to practitioners in utilities

Target

	EC legislation	x	associations of energy industry
x	EC level research programmes	x	associations of ICT industry
	national policy makers	x	associations of and for consumers
x	national funding authorities		standardisation bodies
	national regulatory bodies	x	curriculum developers
x	local authorities		suppliers to energy industry

Details	S3C (as well as its "sister project" ADVANCED) has gained a lot of insight in user needs and behaviour offering not only in-depth explanations in the various scientific documents, but also practical guidelines and tools. This know-how is now available for a broad audience. Now these tools need to be conveyed to their users in utilities, energy agencies, municipalities, scientific institutes, project consortia etc. This recommendation calls for support from managers of research programs, associations and local authorities to open opportunities to present these results. First steps have been taken with a webinar together with the Covenant of Mayors and presentations at IEA and ISGAN conferences. Starting with the final conference, the S3C consortium will approach national and European associations in the hopes to find further allies for disseminating the results. The toolset website (with ready to use tools, such as an energy quiz to be integrated at a utility's website) will be available as a focal point for such joint efforts for at least the next five years.
Background	
Comments	

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