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Report on innovative interaction schemes

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Abstract:

This deliverable describes and analyses the innovative schemes that have been identified within the S3C project, and are not covered by the S3C family of projects described in deliverable 3.2.

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Innovative schemes

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Executive Summary

The objective of this task is to provide examples of ideas for projects identified as innovative interaction schemes which have not been covered in the S3C family of projects and report the most promising and interesting features of these schemes.

This deliverable contains some relevant details of the above-mentioned ideas and an analysis of the schemes based on the challenges and research questions identified within the S3C project. The results will be used for the next important step within the S3C project; the cross-sector analysis in task 3.4. The first results from the analysis of the S3C family of projects in deliverable 3.2 will also provide input to the work in task 3.4.

Authors

Partner	Name	Phone / Fax / e-mail
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SP	Maria Thomtén	Maria.thomten@sp.se
	Magnus Brolin	Magnus.brolin@sp.se
	Magdalena Boork	Magdalena.boork@sp.se

RSE	Simone Maggiore	simone.maggiore@rse-web.it
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INEA	Gregor Cerne	gregor.cerne@inea.si
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EDP	Diogo Ramalho	diogo.ramalho@edp.pt
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BAUM	Philipp Reiß	p.reiss@baumgroup.de
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List of acronyms

AD: Active Demand

ADR: Automated Demand Response

AMI: Advanced Metering Infrastructure

API: Application programming interface

CPP: Critical Peak Pricing

DER: Distributed Energy Resources

DR: Demand Response

DSM: Demand Side Management

DSO: Distribution System Operator

EV: Electric Vehicles

FoP: Family of Projects

ICT: Information and Communications Technology

IHD: In-House Displays

KPI: Key Performance Indicator

LBR: Load balance responsible

NEEX is the „New European Energy Exchange“, a spot market on the European level Virtual Prosumer,

RES: Renewable Energy Sources

S3C: Smart Consumer, Customer, Citizen

SMEs: Small and Medium-sized Enterprises

VPP: Virtual Power Plant

1. Introduction

Although many demonstrations incorporating end-user involvement and interaction have been performed, some interaction schemes have not yet been tested in pilot and demonstration projects and will therefore not be captured by the analyses performed in Task 3.2. Moreover, the S3C family of projects will not be able to cover all types of schemes that are tested all over Europe. Therefore, the work in Task 3.3 is meant to complement the S3C family of projects through identifying and analysing innovative schemes with the potential to increase user activity that are not being covered in the identified family of projects, which has been reported in D3.2. Innovative schemes are an important element in the S3C work, since they can provide an indication of the direction of the trends in end-user engagement in smart grids. The outcome of task 3.3 will be used as input for the analysis in task 3.4 which in turn will provide a basis for the development of the S3C toolkit.

Methodology

The work within this task is done in two steps; gathering innovative ideas from across Europe, and thereafter analysing the proposed schemes. All contributing consortium partners have been involved with capturing innovative schemes through interaction with various stakeholders and experts:

- The S3C Advisory & Dissemination Board
- Researchers at partner organizations
- Interviewees from the S3C Family of Projects
- Other actors in the field of smart grids

The S3C Advisory & Dissemination Board

In September 2013, an S3C Advisory & Dissemination Board meeting was held in Brussels. The group holds high-level members within the field of smart grids and social sciences from a number of different EU countries. The purpose of the meeting was to gather input on the work done in S3C and to discuss ideas for the future. The afternoon workshop session on innovative schemes provided some input to task 3.3. The ideas from the group have been further elaborated by SP.

Researchers, interviewees and other sources in the field of smart grids

Some ideas for innovative schemes have been gathered from in-house knowledge and experience from experts and researchers within consortium member organizations. Many of these specialists have worked in the field of social sciences and/or related technology, in pilots involving end-user behaviour and energy innovations in smart grids. From discussions and interviews with these researchers and specialists, an outline of what could be, according to their experiences and studies, the most outstanding and at the same time the most effective methods to increase the social acceptability of an innovation aimed at bringing about a change in end users' life and therefore affecting their daily routine. Additionally, some input has been captured from interviews with project leaders from the S3C family of projects, who also hold many years of experience from smart grid field tests.

Other actors in the field of smart grids have been involved through discussions and workshops. Also, literature reviews of research and studies within the field have been conducted. One example can be found in the six E-Energy model regions in Germany, who managed to connect nearly 4000 customers in Smart Grid infrastructures between 2009 and 2013 and came together on a regular basis within the Task Force "Market and Business Models". The different approaches in recruiting customers and ideas for consumption management in households that were trialled in the six regions ensured a comprehensive idea of the overall options in the area of end-user engagement. Three of the most interesting examples of interaction schemes untested (within E-Energy) that have been discussed throughout the four year programme will be summarized as input. Another example is the ZESMIT project, which is funded by the German Ministry of Economics and Technology as a part of the E-Energy initiative and tasked with developing use-case scenarios and new smart applications in the smart grid sector. In this context, the project relies on a preliminary analysis of the status quo, future trends in technology as well as business and society. The Institute frequently publishes Trend Reports for the ICT-sector and has so far published two reports specifically tailored to ICT for a future energy system which feature ideas for value-added apps for end-users that have remained untested so far. The research for these publications was carried out under the ZESMIT-project and has been a source of inspiration for some of the innovative schemes in this report.

Structure of the report

The ideas for innovative schemes are presented in alphabetical order in chapter 2 of this report. A final analysis has been performed by SP, with the aim to capture future trends in the field. A brief description of the analysis is presented along with the results in the final chapter.

2. Innovative interaction schemes

2.1 App for individualized load-curve based energy consulting services

App for individualized load-curve based energy consulting services	
Idea reported by	BAUM
Source/based on	Information from the E-Energy task force “Market and business models”
References	-
Related keywords	Products & services, end-user feedback

2.1.1 Short description of the scheme [what?]

Summarize briefly the scheme (measures, incentives, to what end shall the tool be developed, for which target group(s); which actor/party takes the initiative, etc.)

The model region eTelligence developed a feedback app for its consumers that can already be considered best practice, as it applies easy-to-understand information and social comparisons, in order to activate the customers. However, the consortium would have liked to add another energy-consulting-functionality. Data Analysis offers value-added services for a feedback-app and renders the end-user able to become proactive regarding the energy efficiency in their household.

The end-user would have to consent to their smart meter data being processed and analysed by the app-programmer that can detect “electricity hogs” in the households the end-user has not discovered yet.

2.1.2 Objectives [why?]

What is the purpose for developing the scheme? Is there a specific problem that needs solving? Which objectives could be met through the scheme?

The consortium sought to develop algorithms that detect the typical load profiles of household appliances, i.e. the washing machine or the dish washer, in the smart meter data. Most household-appliances leave a “fingerprint” in an exactly metered load-curve of a household.

If a household appliance required a higher load than a certain defined average for this appliance, the app could send the end-user a notice regarding the inefficient household application and give him hints and tips on where to acquire a new, more efficient version. In a best case, the app could estimate how much money the consumer could save each month by switching to a more energy-efficient application and calculate how long it could take to amortize the investment.

2.1.3 Actor(s) and target group(s) [who?]

Which actors and stakeholders should be involved in developing the scheme, and for which target group(s)? How will the scheme relate to consumers, customers, citizens?

- The tool idea was developed by the consortium consisting of a supplier, a DSO and ICT firm.
- The tool was developed for residential end-users.
- This tool could especially help the S3C Smart Consumer and Smart Customer perspective as it helps the end-user to make informed decisions.

2.1.4 Relevance for S3C

Explain why the scheme is relevant for SC and how it relates to S3C objectives? Why should it be considered innovative? What is the learning potential for S3C, and which elements are transferable?

The scheme helps end-users to make informed decisions and to learn about their individual consumption patterns. The innovative approach of the scheme lies in the combination of several functionalities, and that the scheme individualizes them for the respective end-user.

The scheme offers value-added services based on the metered load-curves of individual households and does not only confront them with the mere information on power and electricity use, but renders individualized tips on how to act on the information. The idea could be offered as an idea or tool to active partners in S3C.

2.1.5 Current status and future outlook

Is the scheme already implemented? What experience and results are there so far? Is there research data/evidence available?

The app was not programmed and implemented within the eTelligence project due to time and budget reasons. The consortium only developed the idea.

2.1.6 Other

Describe relevant aspects of the scheme that has not been captured in the sections above.

Existing data protection laws as well as general sensitivity of end-users regarding the use of their personal data are strong barriers.

First simulations show that up to 98% of appliances can successfully be detected in individual load profiles. However, the accuracy of the advice given to the end-users has to be ensured. If the app makes a wrong suggestion, the frustration potential of the end-user is high and likely to lead him to discard of the use altogether.

2.2 Consumption notification programs

Consumption notification programs	
Idea reported by	INEA
Source/based on	
References	Slovenian Energy Agency (2012), Slovenian Energy Agency (2011)
Related keywords	Products & services

2.2.1 Short description of the scheme [what?]

Summarize briefly the scheme (measures, incentives, to what end shall the tool be developed, for which target group(s); which actor/party takes the initiative, etc.)

The scheme performs the function of informing the end-user in case of certain specified events. Examples are a fuse burn-out, low voltage (e.g. battery, electric vehicle), unusually high power consumption (threat of power supply outage), power supply interruptions (expected and unexpected), device operation on hold due to some malfunction etc. In the case of such events, an immediate and automatically generated message enables a fast response by the end-user or operator. Messages can be sent out by the energy retailer, grid operator or the operator of end-user appliances. The messages are sent from the service provider's control centre as text messages to a mobile phone or as e-mails. The scheme contributes to the increased reliability of power supply (warning of high power consumption or low voltage could prevent a power outage), lowers possible downtime (fast response to a notification enables quicker recovery from power outage), reduces the costs of power supply, etc.

2.2.2 Objectives [why?]

What is the purpose for developing the scheme? Is there a specific problem that needs solving? Which objectives could be met through the scheme?

The purpose and the objectives of the DSM service are to:

- Inform consumers of their unexpected, harmful power consumption events.
- Shorten the reaction time after harmful events and decrease downtime.
- Increase the reliability of the power supply, by preventing power outages.

2.2.3 Actor(s) and target group(s) [who?]

Which actors and stakeholders should be involved in developing the scheme, and for which target group(s)? How will the scheme relate to consumers, customers, citizens?

The tool is developed by the service provider. Besides some standard functionality it also enables end users to configure the service alarms according to his needs and specifications. It is recommended that the scheme is integrated into the same environment as a home automation system, which involves also the building owners and related entities. The target groups are private/residential end-users and small and medium-sized enterprises (SMEs).

The scheme can be considered as an additional service to smart energy use, since its function is only to provide information on the reliability of the supply. The end users are directly related since notifications as a part of a home automation system perform their function locally to provide technically superior power supply (safety, less outages, less downtime) resulting also in lower maintenance and indirect costs (loss of income due to no operation). The scheme is mainly addressing the S3C Smart Consumer.

2.2.4 Relevance for S3C

Explain why the scheme is relevant for SC and how it relates to S3C objectives? Why should it be considered innovative? What is the learning potential for S3C, and which elements are transferable?

The notification scheme contributes to the increased reliability of energy supply for end-users. In this respect it is a general and widely applicable service, which helps in gaining the trust of the users to take on more "active" roles in the implementation and functioning of the future energy system. It could possibly enable easier acceptance of the other smart grid services like demand response.

The application of a notification scheme in the field of power supply for individual end-users has been recognized as a promising feature of the future smart grid that ought to be legally supported and standardised¹, so competing vendors can offer it.

The scheme provides additional functionality to the already available schemes in the S3C family of projects, such as home automation systems and thus contributes to the user oriented smart grid services. The communication part of the scheme like mobile text messaging and e-mail notifications may be used to support already existing services. Further progress is needed in the development of the standardized open communication interface at the end-user level and the development of acceptable business models for end-user charging.

2.2.5 Current status and future outlook

Is the scheme already implemented? What experience and results are there so far? Is there research data/evidence available?

The service was proposed during of the inquiry process of the Slovenian regulatory body. Next step is the specification of the legal issues of the service.

2.2.6 Other

Describe relevant aspects of the scheme that has not been captured in the sections above.

The scheme requires the availability of Advanced Metering Infrastructure (AMI), which usually falls under the responsibility of the grid operator. However, the provision of this event notification service is considered to be a commercial activity, while the grid operator is not allowed to operate on this commercial market. Therefore it is necessary to open the communication interface for competitive service providers.

¹ Slovenian Energy Agency (2011)

2.3 ECooperation

ECooperation	
Idea reported by	BAUM
Source/based on	Information from the German CDTM and its Trend Reports, ZESMIT project
References	Braun, B. et al (2009), Braun, M. et al (2009)
Related keywords	Products & services

2.3.1 Short description of the scheme [what?]

Summarize briefly the scheme (measures, incentives, to what end shall the tool be developed, for which target group(s); which actor/party takes the initiative, etc.)

The business sector consumes much more electricity than the private sector. Starting up energy efficiency initiatives in this sector will be very fruitful. Based on ICT and energy efficiency technologies the huge saving potential can be activated. The idea behind the consulting service ECooperation is twofold. On the one side, the energy efficiency of the involved companies can be maximized, on the other side, the energy produced and consumed by the companies of the network will be managed, used as efficiently as possible enabling maximum cost reductions.

For the development of this tool, a scenario was constructed and the tool was designed based on the assumptions made there. In the next section, the added value will be summarized, then the scenario will be described, subsequently the project ECooperation will be presented. The findings in this chapter are based on Braun, M. et al. (2009).

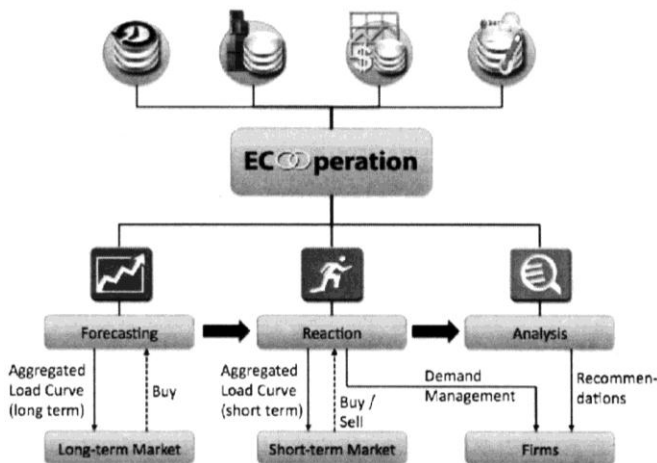


Figure 7.8: ECooperation's core service

Figure 1: ECooperation's core service (source: Braun M. et al. (2009), p.214)

ECooperation's aim is to consult companies with the aim of increasing energy efficiency. The goal is to forecast the estimated demand and supply, analyse load curves, detect potentials for energy efficiency and cost saving. However, the most unique characteristic is that energy-related questions are managed within a network of firms. So the results of the analyses and forecasts are used to coordinate the energy supply and demand in the whole network of firms to enable possible synergies. The scenario ECooperation acts on the assumption that automated energy efficiency systems are already installed that can serve as a basis for the ECooperation service.

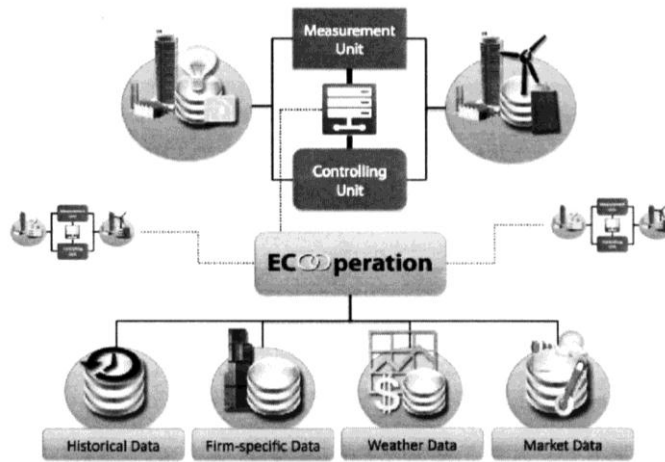


Figure 7.10: ECOperation's data gathering and analysis infrastructure

Figure 2: ECOperation's data gathering and analysis infrastructure (source: Braun M. et al. (2009), p.216)

The analyses and forecasting of load curves enables ECOperation to buy on the long-term energy markets, based on the aggregated data of the network of firms. In case of sudden undersupply, ECOperation can either buy on the short-term market or it can regulate the overall demand down in predefined ways. And of course energy efficiency measures will be strengthened within the firms of the network. The firms of the network are therefore enabled to concentrate on their core business.

The service offered by ECOperation is available through an online portal as well, where firms may have detailed access and are able to contact other firms of the network. The collaboration of a variety of firms with different experiences in energy saving enables them to share their experiences. Further the participation within the brand ECOperation can have an added value for marketing.

Concerning the target customer, the goal will be to create a portfolio of companies with complementary characteristics. Therefore, three core criteria will be used:

- Contribution to the load curve which fits to the entire network, which means the possibility to shift or cut energy consumption, if needed
- Companies which can have a levelled electricity consumption regarding the volatile generation from RES and/or produce energy from RES.
- Ecological standards used for the end-products and in the internal organization are crucial, if the label ECOperation is also used for image and marketing

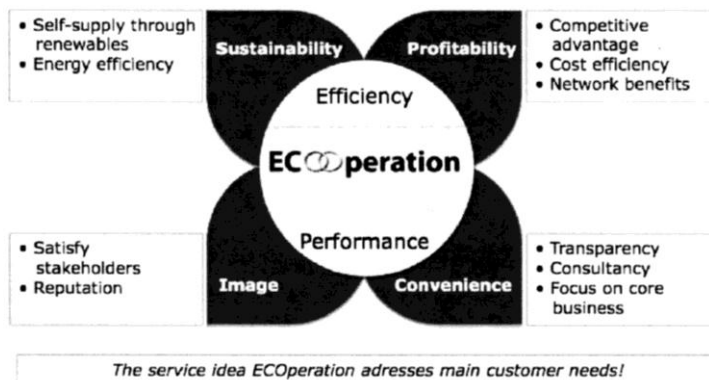


Figure 7.11: ECOperation's Power-Flower to address customer needs

Figure 3: ECOperation customer needs (source: Braun M. et al. (2009), p.219)

2.3.2 Objectives [why?]

What is the purpose for developing the scheme? Is there a specific problem that needs solving? Which objectives could be met through the scheme?

ECOoperation enables medium sized companies and large enterprises to concentrate on their core business, while their energy efficiency and their load curve will be optimized. The forecasting of demand and supply, the analyses of load curves and the fostering of energy efficiency are the core services. But all the services will be carried out within a network of firms, which can create synergies and allows the flexibility management to act on a bigger scale on the energy markets. Flexibility can be offered within the network.

Furthermore, due to the combination of a variety of firms, different experiences in energy saving can be shared and experiences can be exchanged. The brand ECOoperation can reach a status which makes the participation within the network a must-have for marketing.

2.3.3 Actor(s) and target group(s) [who?]

Which actors and stakeholders should be involved in developing the scheme, and for which target group(s)? How will the scheme relate to consumers, customers, citizens?

The tool has already been developed by students and university staff throughout the ZESMIT project. The target group is commercial end-users.

This is a tool that touches among all the c-dimensions of S3C. It enhances the options to participate in markets, relates to the self-awareness and the image of companies, has a strong community and experience-sharing focus and does not decrease the comfort of the users too much.

2.3.4 Relevance for S3C

Explain why the scheme is relevant for SC and how it relates to S3C objectives? Why should it be considered innovative? What is the learning potential for S3C, and which elements are transferable?

This tool combines traditional energy management and energy efficiency measures and is inspiring to help foster smart energy behaviour due to the combination of not only monetary incentives deriving from energy efficiency and load shifting measures, but also the community efforts that are incorporated in the scheme.

2.3.5 Current status and future outlook

Is the scheme already implemented? What experience and results are there so far? Is there research data/evidence available?

For the construction of the scenarios, different drivers have been analysed. On the one, hand the certain drivers have been defined and analysed, like environmental awareness, scarcity of resources, the extension of product portfolios and the profitability of energy investments. On the other hand, uncertain drivers were analysed as well, like efficient energy consumption technologies (key driver), efficient energy production technologies (key drivers), energy efficiency cooperations (key driver), regulations & promotion of energy efficiency, volatility of energy supply and privacy sensitivity.

Based on these drivers (mainly the key drivers) three different scenarios have been developed depending on different assumptions about their development:

- Low Hanging Fruits
- OptiMax²
- Act Locally Think Globally

The development of the service idea ECOoperation is based on the last scenario, in which the key drivers have the biggest influence. The general public shows a high environmental awareness in the scenario “Act Locally Think Globally”. The efficient production technologies and efficient consumption technologies are well developed and firms are willing to start strategic cooperation to balance risks. This results in huge untapped potentials for energy efficiency measures. Another quality of this scenario is that energy production is organized by many companies on their own using renewable energies. The need for energy efficiency measures resulted in the installation of many automated energy efficiency systems in medium sized companies and large corporations.

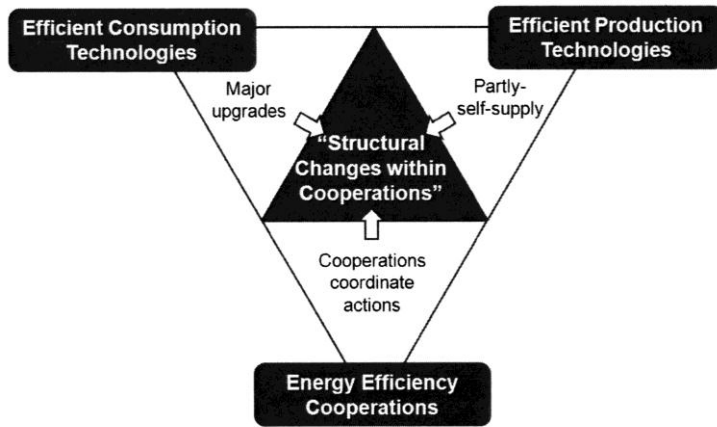


Figure 7.7: Structural Changes within Cooperations

Figure 4: structural changes within coopeations (source: Braun M. et al. (2009), p.206)

2.3.6 Other

Describe relevant aspects of the scheme that has not been captured in the sections above.

N/A.

2.4 EEnergy OS

EEnergy OS	
Idea reported by	BAUM
Source/based on	Information from the German CDTM and its Trend Reports, ZESMIT project
References	Al-Ali, M. et al (2009), Lorenz, M.-L. et al (2009) Microsoft Hohm website, Google PowerMeter website, Opower website
Related keywords	Products & services, end-user feedback

2.4.1 Short description of the scheme [what?]

Summarize briefly the scheme (measures, incentives, to what end shall the tool be developed, for which target group(s); which actor/party takes the initiative, etc.)

EEnergyOS is a “Cloud computing operating system which connects the island solutions of different manufacturers in order to realize overall energy management”². For the development of this tool, a scenario was constructed and the tool was designed based on the assumptions made there. In the next section the added value will be summarized, then the scenario will be described, subsequently the EEnergyOS will be presented. The findings in this chapter are based mainly based on chapter six in Lorenz et al. (2009).

EEnergyOS will be a cloud computing operating system focusing on efficiently and proactively managing energy consumption in a Smart Home. A service platform will be included which offers the opportunity to control the different appliances and to install applications which allow enhancing the functionalities of the appliances. It can control all energy sources and appliances in the household such as heating and cooling, but it is optimized for electricity consumption. The system can display extensive information about the current and historic energy consumption for the whole household and for any connected appliance. Furthermore, it can communicate with the utility and is able to visualize where the used energy comes from (e.g. renewables, coal ...). In summary, it communicates with the outer world, the installed appliances and the inhabitants of the household.

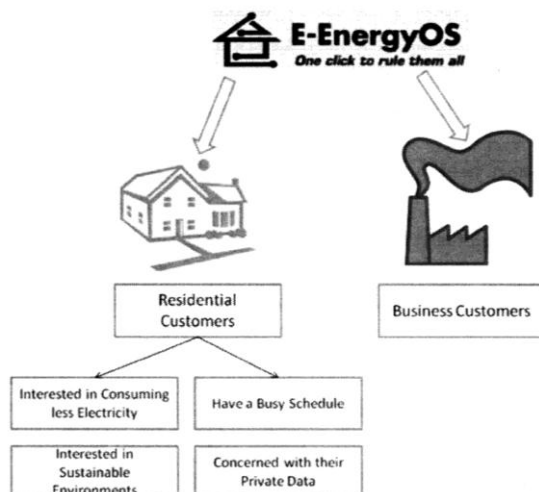


Figure 6.12: E-EnergyOS customer profile

Figure 5: EEnergyOS customer profile (source: Al-Ali et al., 2009, p. 168)

Due to this communication channels, it can be used for demand side management and for demand response and is able to shift devices' consumption automatically depending on the availability and/or the

² Al-Ali et al. (2009), p. 128

price of electricity. For prosumers, the EEnergyOS offers an additional broker service. The user only has to specify some constraints about the selling price, markets etc.

There will be two ways to use the EEnergyOS: It can be used in pilot mode where decisions are made by the system itself, or it can be used in manual mode where the user makes the decisions and the system makes recommendation about the energy optimization. These recommendations will be based on the behavioural patterns of the user which are tracked by the system. A built-in firewall (comparable to firewalls for PCs) guarantees the safety of the system. The user can define which data should be blocked or allowed.

The system will reduce the complexity of Smart Homes and makes them accessible for people who are not familiar with technology or electricity tariffs. The open nature and platform of the system and its API (Application programming interface) makes it easy for software developers to create new software and enhance its core functions. The system itself is foremost an online platform hosted on remote servers, but the gateways are installed in the households. The concept of the EEnergyOS is based on systems like Microsoft Hohm³ or Google PowerMeter⁴, which both started in 2009 and were been abandoned in 2012 and 2011 due to a lack of consumer update and interest. But these concepts are not as advanced as the concept of EEnergyOS. A similar software which is still on the market is OPower⁵.

Due to the interconnectivity between different smart appliances and sensors, the system can seek for synergies in order to optimize energy consumption and due to its open architecture (API's etc.) it can execute further services beyond saving energy, such as housesitting, remote control which result in an enhanced living comfort.

2.4.2 Objectives [why?]

*What is the purpose for developing the scheme? Is there a specific problem that needs solving?
Which objectives could be met through the scheme?*

The EEnergyOS provides one unique interface for all energy appliances in the household. It bridges the gap between different standards and interfaces and enables the user to (remotely) control all smart appliances in the household with one device. It also displays the current and historic consumption in different customizable ways. The third core functionality is the communication with the "outer world". EEnergyOS collects relevant information for the user (e.g. which source does the electricity come from? how expensive is one kWh? ...) and can act as a broker on energy markets (e.g. for prosumer, demand side management, demand response). The functions can be enhanced with software extension. Due to the access to all smart devices and sensors other application areas are possible with different premium add-ons, like for example housesitting, automated light/heating/cooling control, etc.

The problem for the user in the described scenario is mainly the missing link between the different advanced smart appliances. Therefore, EEnergyOS aims to be a unique user interface which can be used to control the appliances with one interface instead of many different interfaces from the different smart appliances. It could bridge the gap and achieve interconnectivity between home appliances in heterogenic Smart Homes.

³ Microsoft Hohm website

⁴ Google PowerMeter website

⁵ Opower website

2.4.3 Actor(s) and target group(s) [who?]

Which actors and stakeholders should be involved in developing the scheme, and for which target group(s)? How will the scheme relate to consumers, customers, citizens?

The tool has already been developed by students and university staff throughout the ZESMIT project. The target group is residential end-users. It is of particular relevance to the S3C Customer dimension as it enables the end-user to take part in the energy markets actively.

2.4.4 Relevance for S3C

Explain why the scheme is relevant for SC and how it relates to S3C objectives? Why should it be considered innovative? What is the learning potential for S3C, and which elements are transferable?

The tool enhances the role of the end-user and puts him in a position where he can actively take part in the energy market. Furthermore, it increases the comfort of the end-user, as all household appliances can be controlled in a central system.

2.4.5 Current status and future outlook

Is the scheme already implemented? What experience and results are there so far? Is there research data/evidence available?

The tool has been developed, but it has not been tested in a field trial so far (as far as the S3C team knows). For the development of the EEnergyOS, three different scenarios depending on the development of different drivers have been developed. The drivers were divided into certain drivers like demographics, households, environmental awareness and decentralized energy production and uncertain drivers like efficient energy storage, standardization efforts of the markets players and privacy. Further the uncertain drivers governmental efforts, customer demands and needs and smart home appliances were defined as key drivers for the scenarios. The results of this process were three different scenarios.

EEnergyOS are based on just one scenario called “Isolated Islands” for which the following developments were predicted: Due to limited national and European efforts, there is no ubiquitous standard (key driver governmental efforts). Instead, different consortia with many different standards and interfaces exist. The customer acceptance for these devices is very high, which causes a fast spread of isolated solutions (key driver customer demands and needs). The smart home appliances in this scenario offer a high benefit to the user and are easy to understand and use, but are very expensive which results in “islands of smart devices” (key driver smart home appliances).

In this scenario, Smart Homes are equipped with independent and customized appliances and appliances systems. There are different solutions with different standards for Smart Home appliances which do not communicate with each other. Smart Homes are not fully automated in this scenario, but they are able to gather information and inform the user. The smartness of these houses and the inclusion and interaction of these highly developed devices depends strongly on the smartness of the individual user and its resources.

2.4.6 Other

Describe relevant aspects of the scheme that has not been captured in the sections above.

Business model:

According to the developed business model for EEnergyOS, a slightly modified freemium model is favoured, which means, that the service itself is almost free but it can be upgraded with premium add-ons. Additionally, the user pays 15% of the savings made by using the service. If no money will be saved, the service is free. For the premium add-ons monthly costs are designated, but it will be possible to cancel the contract every month (there will be no minimum stay contracts). Furthermore, a virtual marketplace for third-party applications will be installed. Developers are able to programme add-ons for the EEnergyOS. They can decide the price of the applications for themselves, but have to pay a commission of 15% for every sale.

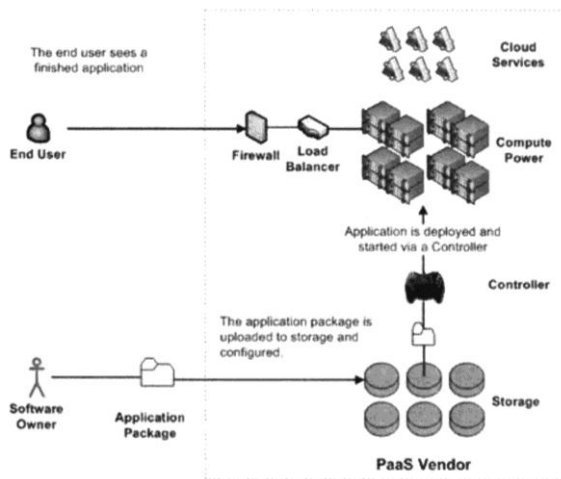


Figure 6.11: E-EnergyOS PaaS architecture
Source: Pijanowski [273]

Figure 6: Energy OS architecture (source: Al-Ali et al., 2009, p.167)

2.5 End-user behaviour classification

End user behaviour classification	
Idea reported by	INEA
Source/based on	
References	Slovenian Energy Agency (2012), Slovenian Energy Agency (2011) Enernoc website
Related keywords	Incentives & pricing schemes

3.5.1 Short description of the scheme [what?]

Summarize briefly the scheme (measures, incentives, to what end shall the tool be developed, for which target group(s); which actor/party takes the initiative, etc.)

The service provider defines several electricity supply packages based on performance indicators. The supply packages are ranked according to the efficiency of end-use energy consumption and have corresponding incentives, i.e. the most efficient package has the highest incentives/lowest price for the end user. The end user, which would like to use the scheme, is linked to a specific package according to his past measured behaviour and performance indicator values. The service provider informs the end users about his consumption patterns. Based on that information it also provides the conditions and hints to the end user for changing the behaviour and to enter into the more efficient (and cheaper) package. The reverse process is also possible – in the case of less efficient consumption the end user is warned and then “degraded” to more expensive package.

A concrete example can be the more even distribution of consumption patterns over time. The grid operator prefers consumers with a flat consumption profile. It defines the performance indicator (i.e. ratio between the peak consumption and average consumption) and defines the efficiency classes (i.e.: from class A: below 1.2 to class E: above 4.0). The end user is entered into the particular class according to the measurements for a period of the last three months. During the operation the service provider informs the end user about its current indicator value. When the end user manages to fulfil the conditions of the higher class for a certain time (e.g. 3 months) he is granted to enter the class with higher label.

The scheme may beside from the flat profile-case be used for several services where the corresponding indicator can be defined, i.e.: specific consumption, demand response reliability, specific energy amount shift, evening peak contribution, etc.

2.5.2 Objectives [why?]

What is the purpose for developing the scheme? Is there a specific problem that needs solving? Which objectives could be met through the scheme?

The scheme was originally developed to motivate the end user to increase its demand response reliability. One of its main elements is the “step” approach with classes, which motivates the end user to implement more ambitious efficiency measures in order to accede to a higher class. The elements of the scheme are widely used in other areas like telecommunication and market stores, where consumers are rewarded for consuming more. In the energy sector the approach needs to be reversed to meet the S3C goals – the end user is granted for smarter consumption behaviour. The scheme meets two objectives:

- 1) it motivates the end users for more active participation. They are looking for reserves by themselves instead of an external party forcing them to find a solution; and
- 2) it ensures a fair distribution of incentives.

2.5.3 Actor(s) and target group(s) [who?]

Which actors and stakeholders should be involved in developing the scheme, and for which target group(s)? How will the scheme relate to consumers, customers, citizens?

The tool will be provided by a commercial party like an aggregator or a supplier. The distribution company should also be involved, but since the scheme involves incentives and potential profit earning, it needs the corresponding legal basis for participating in such a scheme. The scheme may address users from all the sectors - Private/residential, commercial and industrial users. It may address also the producers – preferably the non-distributed RES generators. For example the service provider may prefer to get a predictable production of electricity while for instance cogeneration units generate electricity according to the heat demand.

The scheme addresses mostly the S3C Smart Consumer (who is interested in lowering energy bills) and indirectly it addresses the S3C Smart Customer for more active participation.

2.5.4 Relevance for S3C

Explain why the scheme is relevant for SC and how it relates to S3C objectives? Why should it be considered innovative? What is the learning potential for S3C, and which elements are transferable?

The scheme provides an incentive mechanism for several of the S3C objectives, such as consumption efficiency or peak levelling. The scheme itself does not need the smart grid for the implementation, but advanced metering infrastructure contributes to a more efficient use of this scheme.

The scheme has been used in various forms in other fields – e.g. in telecommunication, where the end users who made more extensive use of the services were granted with lower prices. In the energy sector the approach needs to be reversed, what actually has been done with labels for building energy efficiency. One form of the scheme is already used by large industrial consumers. The suppliers make a confidential and end user specific contract with large consumers and the price usually reflects the end user consumption profile. On the distribution part of the grid the business models go to other directions – they propagate various multi tariff models, which are valid for end users regardless of their behaviour. The scheme is assumed to be innovative because it introduces a segmentation of end users and adapts the economic relation between the service provider and service user in the way that would benefit both.

The formation of the corresponding key performance indicator (KPI) is the key element of fostering the smart energy behaviour. The smartness of the KPI directly influences the smart behaviour of the end user. In addition the scheme may also have a wider social effect. The comparison of the efficiency classes among the end users may generate a competition effect and even improve the results. In general the idea does not need modifications to be transferable to S3C.

2.5.5 Current status and future outlook

Is the scheme already implemented? What experience and results are there so far? Is there research data/evidence available?

Specific elements of the scheme are implemented by the Enernoc company, USA (as “End user adaptation reliability”). In other forms it has been used also in other sectors like telecommunication. The schemes have been used for longer period, what is an indication of their efficiency.

2.5.6 Other

Describe relevant aspects of the scheme that has not been captured in the sections above.

The scheme may be used also without monetary incentives. The performance indicators in the numerical form can be used for a comparative evaluation. An interesting form for presentation to the end user may be the one used by the universities when they evaluate the acceptance exams. The students receive their result in the form of percentage related to the overall population that has taken the exam that year. For example the test result 43% means that they manage to solve the test better than 43% of the attendees. The introduction of that indicator form should have a significant end user motivation for changing behaviour.

2.6 Energy blogger

Energy blogger	
Idea reported by	SP
Source/based on	In-house researchers and experts
References	Bengts villablogg and Fru Watt (energy blogs)
Related keywords	Understanding the target groups, products & services, project communication, bottom-up support

2.6.1 Short description of the scheme [what?]

Summarize briefly the scheme (measures, incentives, to what end shall the tool be developed, for which target group(s); which actor/party takes the initiative, etc.)

The energy blogger aims at introducing energy issues to end users without a profound, or even basic, interest in energy use. To catch the attention of the target group(s) the blog is mainly focused on lifestyle issues for example health, furnishings and design. It could, as most blogs, be about anything, but should *not* have an energy focus. The idea is to increase the energy awareness and knowledge of the blog followers by occasionally introducing energy related issues of different types, but also to popularize energy.

The energy blogger is a person – either real or made-up – who preferably has a genuine interest in both the popularized lifestyle issues and energy issues. Energy behaviour, as well as new and exciting products and services, are mentioned in texts and pictures every now and then as part of the everyday life of the blogger. The blogger should be an attractive role-model who people within the target group can relate to. By introducing energy-related topics every so often, the blogger becomes an unexpected ambassador for smart energy behaviour. The blogger spreads information about smart energy behaviour in a fun and easy-going manner. One feature of the blog could be to introduce new energy efficient or smart products and services to the blog followers. The blogger could, for example, try out new gadgets in their home, and present new products and services entering the market – preferably products that suit the contemporary home and/or the modern man. The description of the gadgets should not be concentrated on energy savings, but rather on added values or signals sent to family and friends by using the products, as experienced by the blogger. Creating an image of oneself is assumed to be important to the target group.

Moreover, the energy blogger may compare and show similar products similar to many blogs for parents, where different baby products are presented, (subjectively) tested and (subjectively) evaluated. However, product comparisons and evaluations require not only an independent blogger, but also an individual that is independent of authorities and third parties, since the comparisons won't be objectively presented (objective comparisons contradict the idea of a personal presentation on the blog).

The idea of an energy blogger is knowledge-based rather than product-based. There should be some kind of quality-check for the facts that are put on the blog, but the important aspect is to approach the end-users feelings rather than their thirst for knowledge.

The energy blogger should be independent from commercial interests, as an independent blogger is most likely more trustworthy than a one with commercial dependencies. Moreover, the blogger needs to be very clear about the true identity of him/herself, since the end-user should not feel tricked by the contents of the blog. The independent blogger could either be an individual with strong driving forces to spread information and experiences related to energy behaviour, or s/he could be supported by an independent third party (e.g. an institute, regional or governmental authority, commercially independent energy advisors or similar).

There could be several blogs of this type, but with different focus and kept by bloggers at shifting age, personalities and interests, in order to attract different groups of end-users. Possible target groups mainly include adolescents and young adults. They are often frequent users of Internet, social media and blogs, and may also be difficult to reach by traditional written information. Moreover, young people tend to be influenced by role-models and bloggers to a larger extent, and are also still in the process of settling their routines and habits.

2.6.2 Objectives [why?]

*What is the purpose for developing the scheme? Is there a specific problem that needs solving?
Which objectives could be met through the scheme?*

Energy is in general not considered a hot topic by people in general, and many young people lack interest in energy-related issues and actions. On the other hand, there is a widespread interest in lifestyle issues, as well as in health, design and fashion, and there are many examples of successful young bloggers with a large number of followers.

This measure aims at capturing the interest of specific target groups by using an unexpected role model instead of tedious energy experts. By supplying energy information in an appealing manner, and in small portions, by a person with a desirable lifestyle, behavioural changes may be achieved within the group of blog followers.

2.6.3 Actor(s) and target group(s) [who?]

*Which actors and stakeholders should be involved in developing the scheme, and for which target group(s)?
How will the scheme relate to consumers, customers, citizens?*

Blogs may be directed at any group by addressing various topics provided by bloggers with different personalities, interests and age, but a prerequisite to reach the intended target group is presence on the internet and that they are used to, or willing to get used to, following blogs.

To be trustworthy, the energy blogger should preferably be an individual with both interest and knowledge within energy. S/he should also be commercially independent. Furthermore, for quality assurance there could also be a connection to commercially independent third parties.

2.6.4 Relevance for S3C

Explain why the scheme is relevant for SC and how it relates to S3C objectives? Why should it be considered innovative? What is the learning potential for S3C, and which elements are transferable?

One of the end-user roles in focus for S3C is the Smart Consumer, who is driven by lifestyle routines. This measure is connected to this type of end user, providing input as well as options to the consumer's current lifestyle.

Blogs with energy focus already exist. Even though many of them aim at presenting and explaining energy issues in an easily understandable way, they tend to attract people that are already interested. The innovative part of this measure is to not explicitly start an energy blog, but a lifestyle blog, where energy behaviour is only presented as *one* part of a lifestyle. This has the potential to attract target groups that have not cared about energy at all so far.

2.6.5 Current status and future outlook

Is the scheme already implemented? What experience and results are there so far? Is there research data/evidence available?

There are several examples of blogs with an energy focus, aiming at explaining energy issues in an understandable way to ordinary energy users. Some blogs are very popular (for example the Swedish blogs Bengts villablogg and Fru Watt). However, those blogs will mainly capture the interest of already interested people.

Also, many energy supply companies keep their own blogs to support their customers/potential customers. They usually have a pure energy focus, which again will attract people who are already interested, but they are also commercially dependent, which may make them less trustworthy to the blog followers.

2.6.6 Other

Describe relevant aspects of the scheme that has not been captured in the sections above.

N/A.

2.7 Energy clubs/associations

Energy clubs/associations	
Idea reported by	SP
Source/based on	In-house researchers and experts
References	Hieropgewekt website, De Groene Vogel website
Related keywords	Understanding the target groups, project communication, bottom-up support

2.7.1 Short description of the scheme [what?]

Summarize briefly the scheme (measures, incentives, to what end shall the tool be developed, for which target group(s); which actor/party takes the initiative, etc.)

The overall idea with energy clubs or associations is to gather interested end-users to share and exchange ideas concerning energy efficiency and flexibility with each other, and also for end-user to get information on energy related issues and how these can be managed. Hence, the association acts as an information portal as well as a meeting and knowledge sharing facility. To further attract potential members, such associations can possibly also have a broader field of interest and include other areas, such as other environmental issues, culture, or sports.

2.7.2 Objectives [why?]

What is the purpose for developing the scheme? Is there a specific problem that needs solving? Which objectives could be met through the scheme?

End-users being interested in energy related issues, sharing a concern for the environment, etc., need a meeting point to discuss solutions and possibilities independently from actors on the energy market. Especially this is the case for end-users having a low confidence in the energy market and industry. The social dimension and the possibilities to contribute to other peoples knowledge increase in energy related matters in an open environment can be a powerful driving force. The energy association can thereby facilitate increased energy awareness through social networking and by making various solutions more visible for its members.

2.7.3 Actor(s) and target group(s) [who?]

Which actors and stakeholders should be involved in developing the scheme, and for which target group(s)? How will the scheme relate to consumers, customers, citizens?

The target group consist of end-users having an interest in energy efficiency and other related issues. In cases where the focus is on end-users having a low confidence for the energy companies and industry, the clubs/associations should not be implemented by energy companies in order to be successful. Instead, initiatives on a local/community level, or from organisations such as consumer organisations, are likely to become more successful.

2.7.4 Relevance for S3C

Explain why the scheme is relevant for SC and how it relates to S3C objectives? Why should it be considered innovative? What is the learning potential for S3C, and which elements are transferable?

The schemes relate mainly to the S3C Smart Citizen perspective and can potentially have an impact on the social dimension of the end-users in the energy system. It may not be considered a novelty as it already exists (see below).

2.7.5 Current status and future outlook

Is the scheme already implemented? What experience and results are there so far? Is there research data/evidence available?

Energy associations already exist. An example is the club “Eltian”, which is a club for end-users with biobased electricity at Sala-Heby in Sweden. The club members also share a cultural interest and their activities. However, this is a club initiated by the local energy company and is not originating from the “grass root” level.

In the Netherlands there is an increasing number of grassroots energy-based initiatives in local communities such as neighbourhoods and villages (some examples can be found in the Hieropgewekt website), and there are quite a few energy clubs/associations. Some contain combinations of other schemes mentioned in this report or other inspiring interventions, such as citizens volunteering as energy coaches (to inform fellow citizens about energy efficiency in their homes) and involvement of civil society organizations (primary schools, churches/mosques) to foster energy awareness. One specific example is the “De Groene Vogel” neighbourhood project.

2.7.6 Other

Describe relevant aspects of the scheme that has not been captured in the sections above.

N/A.

2.8 Energy management systems balancing energy consumption and generation for consumers

Energy management systems balancing energy consumption and generation for consumers	
Idea reported by	BAUM
Source/based on	Information from the E-Energy task force “Market and business models”
References	-
Related keywords	Products & services

2.8.1 Short description of the scheme [what?]

Summarize briefly the scheme (measures, incentives, to what end shall the tool be developed, for which target group(s); which actor/party takes the initiative, etc.)

A general tendency towards an autonomous energy supply leads several end-users to purchasing and installing distributed energy resources (DER) on their grounds. However, usually lacking a management system controlling the feed-in from the DER-unit and the household-consumption, the end-users can rarely be sure that they actually use the electricity generated by their plant. The optimization of the own consumption according to the generation from the own DER-units might be an added-value service that a certain customer segment could favour.

Another driver of this functionality is the fact that if the Prosumers strive to consume as much of the electricity generated from their DER-units, the uncontrolled volatile feed-in into the low-voltage distribution grid could be decreased.

2.8.2 Objectives [why?]

What is the purpose for developing the scheme? Is there a specific problem that needs solving? Which objectives could be met through the scheme?

In general, energy management systems cannot only control the applications in one household; they can control smart generation units as well. If the systems are equipped with decentralized intelligence, i.e. algorithms that can ensure a maximized consumption of electricity produced by the own DER-unit, the local generation and consumption can be balanced. Of course, in times of very high generation, an average household will not be able to use all energy consumed, but over time storage units could serve to alleviate this problem. In a short term perspective, a Prosumer household striving for energy autonomy should consider purchasing further new, smart appliances that could function as short-term storage and buffer for excess production, e.g. electric vehicles.

2.8.3 Actor(s) and target group(s) [who?]

Which actors and stakeholders should be involved in developing the scheme, and for which target group(s)? How will the scheme relate to consumers, customers, citizens?

The idea for the tool has been developed in the E-Energy task force market development. But no project has so far developed and implemented this tool in an actual trial (as far as the S3C team knows), and it remains untested.

The target groups would mostly be prosumers, focusing on home owners with generation units and strong interest in the energy field.

The systems would particularly be appealing to Customers and Citizens, as it enables end-users to become (even autonomous) market partners and the purchasing of such equipment is costly and requires a high awareness and interest for energy related topics.

2.8.4 Relevance for S3C

Explain why the scheme is relevant for SC and how it relates to S3C objectives? Why should it be considered innovative? What is the learning potential for S3C, and which elements are transferable?

These systems would be particularly appealing to S3C Smart Customers and Smart Citizens, as it enables end-users to become (even autonomous) market partners and the purchasing of such equipment is costly and requires a high awareness and interest for energy related topics. The idea can be used as input to develop a new idea for S3C tools.

2.8.5 Current status and future outlook

Is the scheme already implemented? What experience and results are there so far? Is there research data/evidence available?

The idea for this scheme has been developed, but remains untested up until now (as far as the S3C team knows).

2.8.6 Other

Describe relevant aspects of the scheme that has not been captured in the sections above.

This functionality is particularly important for Prosumer projects in a Smart Customer or Smart Citizen-oriented Smart Grid trial. The equipment needed to implement such a scenario is still costly and flawed by “teething problems”, which decreases acceptance for the solutions. In fact, the end-users interested in such functionalities are likely driven by idealistic motivations such as autonomous energy supply, environmental protection through green generation etc. The S3C Smart Consumer, who is mainly motivated by financial gains is not likely to be motivated to purchase the costly equipment necessary for this solution.

2.9 Energy recorder

Energy recorder	
Idea reported by	SP
Source/based on	In-house researchers and experts
References	-
Related keywords	Products & services, End-user feedback

2.9.1 Short description of the scheme [what?]

Summarize briefly the scheme (measures, incentives, to what end shall the tool be developed, for which target group(s); which actor/party takes the initiative, etc.)

The “Energy recorder” is a device measuring the energy performance of an individual end-user, which facilitates comparisons, games and visualization of energy usage. This can be viewed as an energy related correspondence to many of the apps and devices used to record physical activities (RunKeeper, Strava etc.). Hence, the energy recorder is an app or a small device that enables the end user to log activities during the day, and compare their energy use with other people. Coupling the device with for example social media gives possibilities for feedback on energy usage, social comparisons, games etc. If the end user is triggered by competition, there is a possibility to earn points or compete how long a certain amount of points lasts.

2.9.2 Objectives [why?]

What is the purpose for developing the scheme? Is there a specific problem that needs solving? Which objectives could be met through the scheme?

End-users being enticed by gaming and performance can become engaged through monitoring devices giving feedback on their energy performance. Especially when addressing end-users with a low interest in energy efficiency and flexibility in a traditional sense, this scheme could provide one possible approach.

2.9.3 Actor(s) and target group(s) [who?]

Which actors and stakeholders should be involved in developing the scheme, and for which target group(s)? How will the scheme relate to consumers, customers, citizens?

Target groups are individuals that are attracted by logging and counting points or numbers, that want to compete and that are triggered by such aspects. Especially groups not being enticed by sustainability concerns can possibly be a target group which can be addressed through this approach. Early adapters who want to show their good habits and behaviour to others. Performance-oriented people should be interested in such an app or device. Also, groups of people in for instance a workplace can compete against each other.

2.9.4 Relevance for S3C

Explain why the scheme is relevant for SC and how it relates to S3C objectives? Why should it be considered innovative? What is the learning potential for S3C, and which elements are transferable?

The scheme relates to the objectives of S3C by addressing the issue of feedback to end-users in order to achieve a change in energy behaviour. Hence, mainly the S3C Smart Consumer role is addressed, but also the Smart Citizen since the social networking and comparisons are a part of the scheme.

2.9.5 Current status and future outlook

Is the scheme already implemented? What experience and results are there so far? Is there research data/evidence available?

The solution already exists in the form of logging apps like RunKeeper. However, developing a device with focus on energy behaviour require a significant amount of development concerning information and data collection, user interaction etc.

2.9.6 Other

Describe relevant aspects of the scheme that has not been captured in the sections above.

N/A.

2.10 Flexibility management with closed contracts

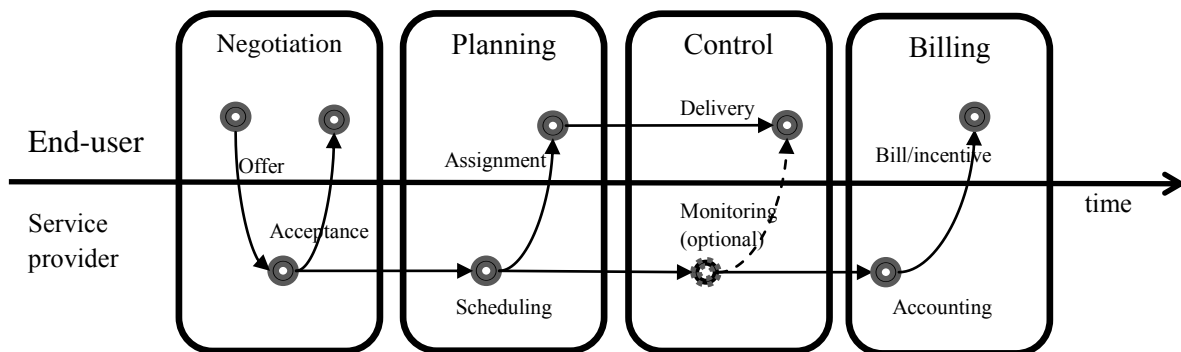
Flexibility management with closed contracts	
Idea reported by	INEA
Source/based on	
References	Mirabel project website
Related keywords	Products & services, incentives & pricing schemes, new market structures

2.10.1 Short description of the scheme [what?]

Summarize briefly the scheme (measures, incentives, to what end shall the tool be developed, for which target group(s); which actor/party takes the initiative, etc.)

Like in the majority of automatic demand response solutions the end-user included in the interaction scheme offers the control of its loads or production units to the service provider. The service provider then schedules their activity according to its target goals (i.e. peak levelling, grid balancing). The main uniqueness of this approach is that the flexibility offer of the end user, which is sent to the service provider, is specified in a closed contract about the energy delivery before the actual consumption happens.

Usually, the agreement between private or business end users and energy suppliers is based on an open contract for energy delivery. This means that only the price of the product is known in advance, while the amount and profile are more or less unlimited. They are accounted for after the delivery of electricity on the base of the metered value. On the other hand the closed contract besides the price exactly specifies also the amount and profile of the energy before it is delivered. The interactions between the consumer and service provider consist of the several phases as presented in the figure bellow.



The main interaction with the end user is provided at the negotiation phase. The end-user first forms the flexible consumption offer and sends it to the service provider. The offer contains the amount of energy (consumed or generated), its time profile, the flexibility parameters and optionally also the price. The flexibility parameters are the minimal and maximal amount of the energy (for production), and earliest and latest time for energy delivery (for consumption). The recommended loads for inclusion into the scheme would be heating and cooling devices, washing machines, etc. Setting the parameters is simplified by adding the advanced control device between the load and energy socket. For example with a washing machine the end user defines two things: 1) By pressing the button the demand response service is activated (if the appliance is not under the end-user manual control) and 2) By pressing another button one defines the time, when the clothes/dishes are going to be washed.

The further process can be fully automated. The service provider first sends the acceptance of the time and price parameter (if any) to the end-user, which is not obliged to follow it. After that the service provider sends the operation schedule, which is within the offer limits, to the device control. The schedule means also that the closed contract between the service provider and end user about the energy delivery is signed. During the operation no action is needed except in special cases where the fully automated solution is not possible. The online monitoring control may be introduced. The financial issues are accounted after the energy delivery (at the end of the month).

2.10.2 Objectives [why?]

What is the purpose for developing the scheme? Is there a specific problem that needs solving? Which objectives could be met through the scheme?

The scheme was developed within the project Mirabel, which purpose was the development of the demand response solution based on the innovative approach with the introduction of the closed contracts on the end user level. The main goal of the projects was more efficient integration of the renewable energy sources in the electricity grid. It was accomplished by the partial transfer of the demand from open to closed contract, what released the corresponding portion of the balancing reserve on the grid, which is used then for the RES. The introduction of the closed contract enables the energy traders to treat the end users with the same principles as they act on the organized market.

2.10.3 Actor(s) and target group(s) [who?]

Which actors and stakeholders should be involved in developing the scheme, and for which target group(s)? How will the scheme relate to consumers, customers, citizens?

The tool is intended to be integrated by the service provider – supplier or aggregator. It may involve also the distributor, because it is suitable to support the system service and it is likely to use the smart meter, which may be owned by him. It also involves the end users, since it needs their permission for the installation of the in-house equipment. The scheme is developed for the residential end-users and SMEs and also large industrial consumers. It prefers to include large energy consumers due to the better cost benefit indicator. It is used for both consumers and producers, who have a control capability. The scheme addresses the smart consumers and smart customers. The first does not need to be very active since the scheme is intended to be automatized to a very high extent. It also relates to the customers since it enables more activity of the end user. For example the end-user may define the price for its flexibility offering and directly participate on the service provider “internal market”.

2.10.4 Relevance for S3C

Explain why the scheme is relevant for SC and how it relates to S3C objectives? Why should it be considered innovative? What is the learning potential for S3C, and which elements are transferable?

The relevance of the scheme for the S3C is expressed through the direct involvement of the end user and its daily operation into the demand response processes. The scheme affects several market roles and end user activities and contributes to the general understanding of the end-user “needs & wants” regarding the interaction with the smart grid.

The scheme has been implemented in at least one European project (see below) and may therefore not be considered a truly innovative scheme. The project Mirabel tested the solution in the simulation and laboratory environment only, while a real environment pilot was not within its scope. It also started the standardization process to open the communication interface between the end user and service provider for competing vendors.

The scheme directly involves the end user into the smart grid functionality. It forces him to think about and plan its consumption (larger flexibility in energy and time results in larger incentives) and consequently changes its consumption pattern.

The S3C project can directly use the economical idea of the scheme and the communication process. Further development requires the end user interaction with the control/communication device. It cannot be unique for all the appliances and must be simple for the user to configure.

2.10.5 Current status and future outlook

Is the scheme already implemented? What experience and results are there so far? Is there research data/evidence available?

A similar scheme has been implemented in the project LINEAR, which is a member of the S3C family of projects (see case report 2.15 of deliverable 3.2 from the S3C project). In the Mirabel project, the solution was installed only in the simulation environment and microgrid test lab, where no real end users were involved.

2.10.6 Other

Describe relevant aspects of the scheme that has not been captured in the sections above.

N/A.

2.11 ICT “extended” solutions

ICT “extended” solutions	
Idea reported by	RSE
Source/based on	Interview with the project leader
References	SPES website
Related keywords	Products & services

2.11.1 Short description of the scheme [what?]

Summarize briefly the scheme (measures, incentives, to what end shall the tool be developed, for which target group(s); which actor/party takes the initiative, etc.)

ICT solutions, such as the ones adopted in the SPES project (see case report 2.28 of deliverable 3.2 from the S3C project) represent a power tool through which end users’ participation is increased. To this aim, a software application was developed and adapted to the needs of people with specific health difficulties; it can be used on a touch screen terminal (without keyboard or mouse) or on a classical laptop: its intuitive user interface has been especially designed to be easy to use by people who are less or even not at all familiar with computers. The software can also be run on a Windows tablet to provide the user with all the functionalities in a mobility context. Although the SPES project focused on telemedicine issues, the learned lessons and the inferred best practices as regards human interaction with technologies can also be applied in the energy related contexts.

2.11.2 Objectives [why?]

What is the purpose for developing the scheme? Is there a specific problem that needs solving? Which objectives could be met through the scheme?

The SPES project’s objectives are to demonstrate the usefulness of telemedicine in the daily life of patients (especially with chronic and serious diseases) and their families and to learn about their interaction of with smart grid technologies: indeed, without a good acceptance of the new technology by patients and doctors, together with an active participation by both, the whole project would not have worked. The ageing of population in the European Area represents one of the largest challenges to be faced in the next few years: different government bodies, like the European Commission, the Member States and the Regions, are, in fact, facing the problem and looking for solutions to improve the quality of life of aged population. The lessons learnt in the field of end user interaction with telemedicine are attempts to give an answer to this kind of problem.

2.11.3 Actor(s) and target group(s) [who?]

Which actors and stakeholders should be involved in developing the scheme, and for which target group(s)? How will the scheme relate to consumers, customers, citizens?

There are four different target groups, each located in a specific location and aiming at different target groups:

- Ferrara pilot (Italy) was targeted to patients affected by chronic respiratory failure, requiring long-term oxygen therapy and non-invasive mechanical ventilation, who are already followed by lung specialists for periodical clinical controls;
- Vienna pilot (Austria) tried to find tailor-made solutions for persons with dementia with levels 1-2 (the total levels generally used for classification of dementia are 4);
- Boskovice pilot (Czech Republic) was focused on 40 mobility impaired clients of a non-governmental organization DEEP;
- Kosice pilot (Slovakia) endeavored to improve social inclusion of older people, who for many reasons can have many problems related to the social aspects, through adequate ICT solutions.

The scheme is particularly relevant to the S3C Citizen dimension as it creates a favourable environment to include all the end users in a smart community and allow them to participate in the various activities, both energy related and non-energy related ones, especially those with health related issues.

2.11.4 Relevance for S3C

Explain why the scheme is relevant for SC and how it relates to S3C objectives? Why should it be considered innovative? What is the learning potential for S3C, and which elements are transferable?

According to the project coordinator, the main contributions of this project to the development of the smart grids in the future is that it is ascribable as a mobility project and that it uses an “old” technology, where “old” means a common technology already in use for several years, but rethought in the form of new solutions, and considers all the aspects related to the acceptance and daily use of such technology by the final end users. Some best practices have, in fact, been derived, such as the importance of a trusted person through which get in contact with the patients, how the mechanism of emulation worked among them and the ways to stimulate its rise. The tested health care system is a starting point, but the best practices derived can be applied also in other contexts, as well as replicated on a larger scale.

2.11.5 Current status and future outlook

Is the scheme already implemented? What experience and results are there so far? Is there research data/evidence available?

The project is currently in its last phase but some attempts are being made to promote, if possible, a follow-up project on a large scale.

2.11.6 Other

Describe relevant aspects of the scheme that has not been captured in the sections above.

N/A

2.12 Local ambassadors for energy companies

Local ambassadors for energy companies	
Idea reported by	SP
Source/based on	Ideas from the S3C Advisory & Dissemination Board
References	Bounce Energy website
Related keywords	Understanding the target groups, project communication, bottom-up support

2.12.1 Short description of the scheme [what?]

Summarize briefly the scheme (measures, incentives, to what end shall the tool be developed, for which target group(s); which actor/party takes the initiative, etc.)

The idea for this scheme is tailored to energy companies who would like to establish a more personal and close relation to their customers. Large energy companies could recruit ambassadors for the company who would act on a local level, supporting end-users in their neighbourhood by providing information and advice. Thus, energy companies should adopt a traditional social work approach: to identify ‘champions’ and ambassadors on the neighbourhood level. Ambassadors need structure and means like space, logistics or trucks, to reach out to people. This is provided by the energy companies in order to make the ambassadors local faces of the companies and to become activators of communities. In other words, the scheme has a clear benefit for the provider.

2.12.2 Objectives [why?]

What is the purpose for developing the scheme? Is there a specific problem that needs solving? Which objectives could be met through the scheme?

Large energy companies often struggle to establish close relations with their end-users, as opposed to smaller and more local energy companies. Sometimes people seem to feel that these companies don’t have faces, just logos, and lack relations and loyalty to companies. There is a lack of trust in the energy sector and energy companies, which could be solved through this scheme as people generally have more trust in fellow-citizens than in companies.

2.12.3 Actor(s) and target group(s) [who?]

Which actors and stakeholders should be involved in developing the scheme, and for which target group(s)? How will the scheme relate to consumers, customers, citizens?

The interest in introducing such a scheme mainly lies with energy providers, working with strengthening their brand by connecting with end-users on the local level.

The scheme mainly relates to the S3C Smart Consumers and Smart Citizens, since the individual energy consumption is in focus alongside belonging to a neighbourhood.

2.12.4 Relevance for S3C

Explain why the scheme is relevant for SC and how it relates to S3C objectives? Why should it be considered innovative? What is the learning potential for S3C, and which elements are transferable?

The scheme provides an innovative way for large energy companies to reach out to their end-users as if they were small and local energy companies. End-users are hopefully stimulated to change their energy behaviour through increased knowledge about energy and closer relations to their energy companies. However, it has been tested in pilot projects (see below).

2.12.5 Current status and future outlook

Is the scheme already implemented? What experience and results are there so far? Is there research data/evidence available?

The scheme has been implemented in more than one European project. A similar scheme was tested in the S3C case study “Smart grid: rendement voor iedereen” (case study 2.25 of deliverable 3.2 from the S3C project), which implemented a type of project ambassadors. These ambassadors differ slightly from the ones described above, since they are end users that invest their spare time as volunteers to help improving the project. Moreover, several energy companies and energy associations in the U.S use this approach in their business. One example is the company Bounce Energy which has introduced an ambassador program where end-users can earn points to spread the word about their services.

2.12.6 Other

Describe relevant aspects of the scheme that has not been captured in the sections above.

N/A.

2.13 Merging Home automation and energy management

Merging home automation and energy management	
Idea reported by	BAUM
Source/based on	Information from the E-Energy task force “Market and business models”
References	-
Related keywords	Products & services, end-user feedback

2.13.1 Short description of the scheme [what?]

Summarize briefly the scheme (measures, incentives, to what end shall the tool be developed, for which target group(s); which actor/party takes the initiative, etc.)

The model region SmartWatts has been focusing on energy management and developed a translation called EEBus for the interoperable in-house communication regarding energy. In the beginning of the project, the energy management system was supposed to become an entire home automation system including many other functionalities.

2.13.2 Objectives [why?]

What is the purpose for developing the scheme? Is there a specific problem that needs solving? Which objectives could be met through the scheme?

This energy management system could render added-value services to the end-user beyond the energy spectrum that the end-user might value higher than functionalities regarding the low-interest topic electricity.

One security functionality that has been discussed but not implemented was to connect the security system of the house, in particular the security- and door-locking-processes, to the energy functionalities. The energy management system keeps track of the appliances that are switched on, e.g. lights or the stove. When a potentially endangering appliance or an appliance is still on and the end-user wants to leave and lock the door, the overall home management could block the locking process thereby reminding the end-user. Which appliances trigger the door-locking-block could be determined by the end-user in the settings of his home automation/energy management system.

2.13.3 Actor(s) and target group(s) [who?]

Which actors and stakeholders should be involved in developing the scheme, and for which target group(s)? How will the scheme relate to consumers, customers, citizens?

The target group is home owners with a technical affiliation. The scheme especially relates to the S3C Customer dimension and renders the end-user the opportunity to optimize the energy management as a part of the overall smart home management.

2.13.4 Relevance for S3C

Explain why the scheme is relevant for SC and how it relates to S3C objectives? Why should it be considered innovative? What is the learning potential for S3C, and which elements are transferable?

The scheme is related to the Smart Home movement, which is seen as one of the potential drivers for the introduction of Smart Grids, as it enhances the comfort the end-users, who do not have to deal with load-shifting and energy efficiency processes themselves, as they are automated. Furthermore, it links the “low interest” topics to other topics (such as security management) which are considered more interesting by many end-users.

Which elements that would be transferable to S3C cannot be answered, as only the idea was developed, but the exact development of the system and an implementation never took place. The idea could be reformulated and used as input for S3C tools though.

2.13.5 Current status and future outlook

Is the scheme already implemented? What experience and results are there so far? Is there research data/evidence available?

Standardisation issues still render a sound in-house communication, which has to underlie a functioning automated energy management and home automation systems in residential end-user sites, difficult. Up to date, the communication between individual appliances in terms of energy management is still difficult. If the communication process has to include the entire home automation system that includes further communication media and protocols, the need for standardization increases further.

Furthermore, the costs for this kind of approach are still relatively high and the functionalities are mostly interesting for a very technology-oriented and refined customer segment. Contingencies have not been considered yet. In case the inhabitants need to leave their home quickly they cannot consider which appliances are left switched on and off.

2.13.6 Other

Describe relevant aspects of the scheme that has not been captured in the sections above.

N/A.

2.14 Pre-paid electricity account

Pre-paid electricity account	
Idea reported by	INEA
Source/based on	
References	Vodacom website, PrePayPower website
Related keywords	Incentives & pricing schemes

2.14.1 Short description of the scheme [what?]

Summarize briefly the scheme (measures, incentives, to what end shall the tool be developed, for which target group(s); which actor/party takes the initiative, etc.)

The pre-paid electricity service is based on pre-paid mobile phone account, which was introduced to expand the market reach to individuals with poor credit ratings and now it is expanded across the world. Similarly to the mobile phone, the electricity pre-paid account (also referred to as pay-as-you-go, pay and go or prepay) is based on the user purchasing a credit in advance of the actual service use. The purchased credit is used to pay for electricity services at the time when the service is accessed or consumed. If there is no available credit then access to the requested service is denied by the service provider (supplier, aggregator...). Users are able to fill their credit at any time using a variety of payment mechanisms. In a pre-paid account there is no cost incurred in the case of no use or disconnection/re-connection costs. The fixed costs are accounted daily and the end user can monitor the remains of the credit online.

2.14.2 Objectives [why?]

What is the purpose for developing the scheme? Is there a specific problem that needs solving? Which objectives could be met through the scheme?

The purpose of the pre-paid service is to:

- Lower electricity costs for infrequently used facilities.
- Fairer division of costs between stakeholders of jointly owned or rented properties; on the one side the tenant receives the exact amount of electricity as he pays for, and on the other the landlord does not need to consider the (unknown) electricity costs for charging the rent.
- Avoid/reduce disputes over unpaid bills.
- Prevent unexpected (high) electricity costs.
- Expand the market reach towards the groups of customers with new specific services, e.g poor credit ratings.

2.14.3 Actor(s) and target group(s) [who?]

Which actors and stakeholders should be involved in developing the scheme, and for which target group(s)? How will the scheme relate to consumers. customers. citizens?

The tool is developed by a service provider. The main target group is private/residential users: The prepaid model is interesting especially for residential users in the cases of infrequent, intermittent, periodic or seasonal use, such as the cottages and holiday homes, where low utilisation at higher tariff is more cost effective than a standard yearly subscription or monthly flat rates. Furthermore, this scheme could also be used in small business or in the case of shared properties or rental apartments etc., where a tenant can purchase/pay for the electricity according to his own needs (instead of paying flat rates).

The scheme allows for certain groups of users to meet their electricity needs better than with the existing system. It would also enable their better control over the electricity costs; therefore it most suits the Smart Consumers (as defined by S3C).

2.14.4 Relevance for S3C

Explain why the scheme is relevant for SC and how it relates to S3C objectives? Why should it be considered innovative? What is the learning potential for S3C, and which elements are transferable?

With the expansion of the smart energy meters, the pre-paid scheme is an extension to a portfolio of other services in the smart grid environment and it might present a niche market. The primary targets are certain segment of users, which might otherwise be neglected.

The scheme is not really innovative since it is already used in some countries (South Africa, Ireland). It may be considered as a novelty since it has not been widely adopted yet in the energy sector. The smart grid technology with the introduction of monitoring equipment enables its usage in more common way. The potential of the scheme is its simplicity in an otherwise very complex future smart energy paradigm, which might engage marginal groups of users to foster smart energy behaviour instead of rejecting it. It also stimulates users to pay more attention to their electricity consumption patterns and costs, which could, combined with the multi-tariff system, result in behavioural changes of user, i.e. consuming more at off-peak (less expensive) periods. The S3C could use the scheme to address the needs of marginal groups of users more specifically. The scheme could be modified for specific price tariffs (e.g. low, middle, high) of electricity.

2.14.5 Current status and future outlook

Is the scheme already implemented? What experience and results are there so far? Is there research data/evidence available?

The scheme has already been implemented in some countries, but there is no information on experience or results so far. For example, the companies Vodacom and PrePayPower have had the schemes in operation for 10 years in South Africa and Ireland under the names V-time and PrePayPower.

2.14.6 Other

Describe relevant aspects of the scheme that has not been captured in the sections above.

N/A.

2.15 Real-time market for regulating power

Real-time market for regulating power	
Idea reported by	SP
Source/based on	Documentation from existing project and company
References	EA Energianalyse website on the FlexPower project, Expektra website
Related keywords	New market structures

2.15.1 Short description of the scheme [what?]

Summarize briefly the scheme (measures, incentives, to what end shall the tool be developed, for which target group(s); which actor/party takes the initiative, etc.)

This is a new market design to activate a large number of flexible small-scale power units. The aim is to provide regulating power via an aggregated response from numerous units on a volunteer basis. The power units could for instance be remotely controlled electrical heating and cooling units, electrical vehicles, industrial demand and micro generation. The automated control of devices would be based on control algorithm and acting on the price levels from a one-way price signal.

The design of the new real time market model is an extension of the existing regulating market (real-time balancing market) with a one-way price signal for regulating power. The current regulating power will still exist and contribute to the major part of the regulation. The marketplace is designed to marginal pricing: when the system operator selects a bid on the lists, the marginal price is the most expensive bid selected. The market price is sent out as a one-way price signal to all market participants with controllable loads that have decided to participate in the scheme. Response is voluntary and the price is the final settlement. Thus, no online metering of supply is required and no later settlement will be done. No reservation price is paid for subscribers, as this would complicate the setup.

The reaction of these voluntary units is estimated beforehand by the balance responsible, based on the price level, historical data on consumption etc. Deviations are estimated to be small and therefore negligible. The price signal must be fast, for instance in five-minute intervals. The demand should be measured in the same interval and payment arranged after the day is over.

End users are not placing bids on the market themselves, as the load balance responsible (LBR) will be doing this as well as communicating the price from the system operator to end users. When regulating power hasn't been activated, the LBR sends out the current spot price and the actual load response to price signals is automatic according to pre-determined criteria. The complexities with implementing the system lie with the LBR. End users must have an interval meter. Data is used for billing and for creating demand response curves. Metering and billing are done remotely.

2.15.2 Objectives [why?]

What is the purpose for developing the scheme? Is there a specific problem that needs solving? Which objectives could be met through the scheme?

A higher share of intermittent power in the energy system increases the need for regulating power to balance the grid in a short time frame. The need for regulating power is in many countries at present met by central power plants and import/export of electricity to neighbouring countries. An alternative solution could be to use electricity demand and micro generation as regulating power. In the future of an energy system abundant in renewable energy sources, a real-time market for regulating power is one way to facilitate the use of demand and micro generation to regulate the variations.

End users are a large untapped resource, but to activate this resource at the right time is complex. A common solution is virtual power plants (VPPs) and remote control, but some end users are reluctant to being controlled. Thus, creating a market to activate this resource would facilitate the implementation as it removes the need for an aggregator who controls each user individually, and uses a voluntary system instead. This market model would also eliminate the need for VPPs.

2.15.3 Actor(s) and target group(s) [who?]

Which actors and stakeholders should be involved in developing the scheme, and for which target group(s)? How will the scheme relate to consumers, customers, citizens?

The main target group is large and medium size supply and demand. Today, there are several barriers that prevent medium-sized demand to participate in the regulating power market. On the demand side, end users would typically use controllable demands such as electrical heating, pumping or charging of electric vehicles. They would install an automated system reacting on price levels, which would make this system highly predictable. On the supply side, regulating power could be small generation units distributed in the energy system. Households could technically be involved – especially those with electrical heating systems or air conditioning units – but small end users are excluded from the regulatory market and the market model would therefore not apply to this group.

The market model would also be valuable to power utility companies and manufacturers of electrical equipment:

- The marketplace is an opportunity for power utility companies to reduce balancing costs and increase revenues from participation in regulating markets. Power companies are penalized when production does not match consumption, and as the share of intermittent and renewable power is increasing the energy companies experience an increase in balancing costs.
- Manufacturers of electrical equipment could harvest new revenue streams by implementing new features into their product.

The scheme mainly addresses the customer dimension of the S3C end user roles.

2.15.4 Relevance for S3C

Explain why the scheme is relevant for SC and how it relates to S3C objectives? Why should it be considered innovative? What is the learning potential for S3C, and which elements are transferable?

The topic of automation, remote control and aggregation has appeared in several discussions related to task 3.3. However, to avoid scattered aggregation pools a market place must be developed, to gather all the relevant actors on one place. The service is not directly aimed at end-users, but rather an outer “layer” of the DSM context – but it is a vital element to make consumption flexibility work in practice.

2.15.5 Current status and future outlook

Is the scheme already implemented? What experience and results are there so far? Is there research data/evidence available?

The idea has been tested in the Danish project FlexPower, and the project has just published their final reports with results. However, the idea of a virtual market place has only been tested in simulations.

Additionally, the Swedish company Expektra has developed the product “Expektra Green Connect”, which is a consumer driven marketplace for automated demand response which makes flexible load a tradable commodity. Their product is a virtual energy storage system based on a marketplace for automated demand response power. Energy companies can buy flexible load from end-users in order to minimize its costs for unexpected fluctuations in demand and supply. Their new business model sets the consumer as a supplier of storage capacity/balance power and Expektra is a broker of automated demand response to power companies.

2.15.6 Other

Describe relevant aspects of the scheme that has not been captured in the sections above.

N/A.

2.16 Social comparison on aggregated levels

Social comparison on aggregated levels	
Idea reported by	SP
Source/based on	Ideas from the S3C Advisory & Dissemination Board
References	Perth Solar City (2012)
Related keywords	End-user feedback

2.16.1 Short description of the scheme [what?]

Summarize briefly the scheme (measures, incentives, to what end shall the tool be developed, for which target group(s): which actor/partv takes the initiative. etc.)

The idea is to design a scheme that provides large-scale visualizations of the effects from the energy use of large groups of end-users. The effects from individual end-users' consumption are aggregated to show effects of scale, which might be easier for end-users to relate to than the effects from only one individual. The aggregated effects could be visualized on large boards which should be displayed on a spot where it can be seen by many end-users to achieve the aspect of social comparison and "myself/us in the eyes of others". For instance, the displays could be installed on large billboards where many people pass daily, such as commuter hubs, commercial spots in cities, metro lines or alongside city roads.

The aggregation is done on community level, so that the effects from energy use of end-users in one area is displayed. Some relevant visualizations could be environmental, economic or system effects. The effects should be visualized through easy-to-grasp symbols, such as large piles of money for economic effects or grey pollution clouds as symbols for emissions.

An element of competition could be introduced to give an additional edge to the scheme, for instance as a comparison between different neighbourhoods of a city.

2.16.2 Objectives [why?]

What is the purpose for developing the scheme? Is there a specific problem that needs solving? Which objectives could be met through the scheme?

The use of scale when visualizing effects from aggregated energy use is intended to make benefits or negative impact more tangible for individual users. Economic, environmental and system effects are often very limited on a personal level and could therefore preferably be visualized on community, city or country level. For instance, large-scale economic effects of load shifting could be visualized through big piles of money which would be a very visual element. The problem to be solved through the scheme is the complexity that the individual end-user might experience when trying to put their consumption in relation to the real effects.

2.16.3 Actor(s) and target group(s) [who?]

Which actors and stakeholders should be involved in developing the scheme, and for which target group(s)? How will the scheme relate to consumers, customers, citizens?

The visualization scheme could be developed by an actor who aims to make end-users more aware of the effects of energy use or energy savings, such as energy companies, city councils or government organizations. The target groups are individual end-users.

This scheme is aimed towards the S3C Smart Consumer and/or Smart Citizen. The end-user's individual energy use is in focus - aggregated to a higher level - which brings both of these end-user roles into the scheme. The end-users are challenged to change their energy behaviour in order to reduce costs and other effects of the group's consumption. The scheme holds a strong motivation deriving from social comparison in the context of a group.

2.16.4 Relevance for S3C

Explain why the scheme is relevant for SC and how it relates to S3C objectives? Why should it be considered innovative? What is the learning potential for S3C, and which elements are transferable?

The scheme can be considered inspiring to support and foster smart energy behaviour due to the combination of competitive ingredients and the community and individual efforts that are incorporated in the scheme. These aspects are also the innovative elements of the scheme: Visualizing and concretizing the effects of energy use on a large scale. Further innovation potential is brought by introducing competitiveness into the equation. However, as the scheme has already been implemented (see below), it cannot be considered a novelty.

2.16.5 Current status and future outlook

Is the scheme already implemented? What experience and results are there so far? Is there research data/evidence available?

The scheme has already been implemented. For instance, a similar type of project was initiated in 2010, when the campaign “Collective Impact” was launched within the framework of the Perth Solar City program. The aim was to show residents of Perth’s Eastern region that their individual actions, however small, are part of something greater and gave a ‘collective impact’. Evaluations mentioned in the annual report of Perth Solar City (2012) suggest that the campaign had an effect on end-user behaviour and household electricity use, with an average 1.6% reduction within the broad reach marketing area. Moreover, the campaign created 51% customer awareness in its first year.

2.16.6 Other

Describe relevant aspects of the scheme that has not been captured in the sections above.

N/A.

2.17 Storage Cloud

Storage Cloud	
Idea reported by	BAUM
Source/based on	Information from the German CDTM and its Trend Reports, ZESMIT project
References	Braun, B. et al (2009)
Related keywords	Products & services, new market structures

2.17.1 Short description of the scheme [what?]

Summarize briefly the scheme (measures, incentives, to what end shall the tool be developed, for which target group(s); which actor/party takes the initiative, etc.)

For prosumers, storage will be a critical issue, if the feed-in of electricity into the grid is less profitable than consuming it. This is the case in the scenario, on which the product idea “Storage Cloud” depends. The “Storage Cloud” enables prosumers to rent virtual storage capacities. Furthermore, it acts as an aggregator on the energy markets to attain revenues. Another field of business is the cooperation with entities operating with emergency or standby power supply systems.

For this development of this product idea, a scenario was constructed and the tool was designed based on the assumptions made there. In the next section the added value will be summarized, then the scenario will be described, subsequently the product idea “Storage Cloud” and its business model will be presented. The findings in this chapter are based on Braun B. et al. (2009).

The product idea “Storage Cloud” is mainly based on two assumptions. On the one hand, renewables are volatile and depend on different environmental factors (e.g. weather), which can be compensated by advanced storage technologies. They can raise the efficiency and flexibility of energy production and transmission. Furthermore, an advanced storage system can be an important factor for the development for EV as well.

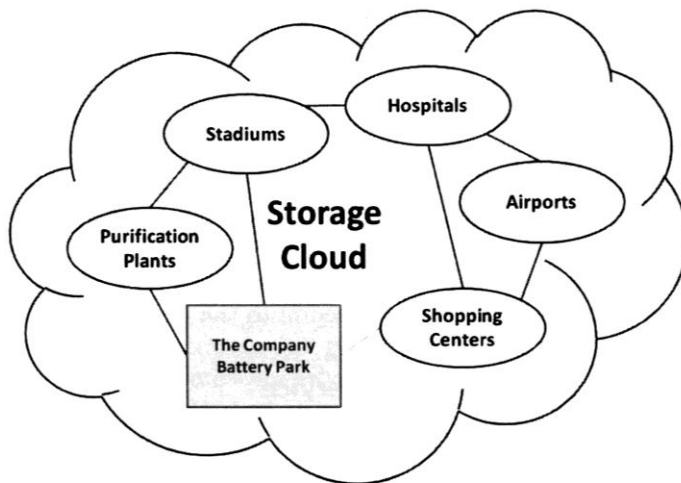


Figure 8.17: Composition of the Storage Cloud

Figure 7: Composition of the storage cloud (source: Braun B. et al. (2009), p.268)

On the other hand, for private households, which own many renewable energy production facilities, a feed-in back into the grid is less rewarding than storage. But the high investment costs are a barrier for the further diffusion of storage facilities.

This leads to the product idea of the “Storage Cloud”. The product “Storage Cloud” will be an external storage provider. The service will be offered for a monthly fee and the revenues will additionally be attained through trading activities with the stored energy on energy markets.

Target group for the product “Storage Cloud” are residential and industrial customers. A reason for offering the service is the need for storage, which is otherwise too expensive. Furthermore, customers of

the “Storage Cloud” do not have to care about maintenance issues. The outsourced storage capacity of the “Storage Cloud” can be used to store electricity when too much is produced and this energy can later be used, when needed.

Every customer will have a personalized account. It will be possible to control the appliance at home, to monitor detailed consumption patterns and to display the monthly savings. The in- and outflow will be managed automatically. The advantages for customers are:

- No personal management of the system is necessary
- Customer has no risk regarding maintenance of storage, place, etc.
- No installation or investment is necessary for the customer

On the technological side, the “Storage Cloud” will consist of decentralized small batteries. This will avoid high initial costs and is flexible for growth of the service.

2.17.2 Objectives [why?]

*What is the purpose for developing the scheme? Is there a specific problem that needs solving?
Which objectives could be met through the scheme?*

The “Storage Cloud” enables private and industrial prosumers to store their energy without having to deal with high investment costs, maintenance and product innovation. Based on forecasting, the stored energy enables the storage provider to act on the electricity markets as an aggregator trading electricity for revenue. Another added value is the cooperation with entities operating with emergency or standby power supply systems.

2.17.3 Actor(s) and target group(s) [who?]

*Which actors and stakeholders should be involved in developing the scheme, and for which target group(s)?
How will the scheme relate to consumers, customers, citizens?*

The tool has already been developed by students and university staff throughout the ZESMIT project. The target group is residential end-users in general and prosumers in particular.

This tool is geared towards the S3C Smart Customer and/or Smart Citizen, since it relies on the purchasing of costly equipment that takes years to amortize, so that a strong motivation deriving from general awareness and/or a tendency to become energy autonomous are required.

2.17.4 Relevance for S3C

Explain why the scheme is relevant for SC and how it relates to S3C objectives? Why should it be considered innovative? What is the learning potential for S3C, and which elements are transferable?

The scheme sheds light on how a Prosumer can be incorporated into Smart Energy structures and under which circumstances it could work.

2.17.5 Current status and future outlook

Is the scheme already implemented? What experience and results are there so far? Is there research data/evidence available?

For the design of the scenario, ten drivers have been analysed. As certain drivers, the development of climate regulations, resource supply, environmental awareness, mobility of society, and demographic changes were researched. The analysed uncertain drivers were governmental push for technology innovations, the development of e-mobility, the technological development, the development of consumer mindset, and the resource costs, at which the three last are defined as key drivers for the design of the scenarios.

Out of the different options for the development of the drivers, three scenarios have been designed. The “European Grid” scenario, in which storage options are poorly developed, but due to advanced transmission technologies, the supply can be balanced. In the second scenario “Central Storage”, large facilities can store energy and balance the load.

The most likely scenario “Integrated Green Future” is characterized by a combination of interconnected central and decentralised storage. The consumer mind set is oriented towards sustainability and includes strong environmental awareness, consumers care about their energy consumption, electric vehicles (EV) are broadly used in inner cities and renewables (mainly wind and photovoltaic) play a significant in the

energy system. Due to the broad diffusion of Smart Grids, the price for energy is variable and time dependent and consumers and prosumers are used to flexible tariffs. In this scenario, consumers produce and use their own energy – which is cheaper than from the electricity from the grid – and become prosumers. The technologies for central storage and batteries are on an advanced level and have an important role in the electricity system. Nevertheless the investments in storage are still very expensive and prevent households from investing into storage.

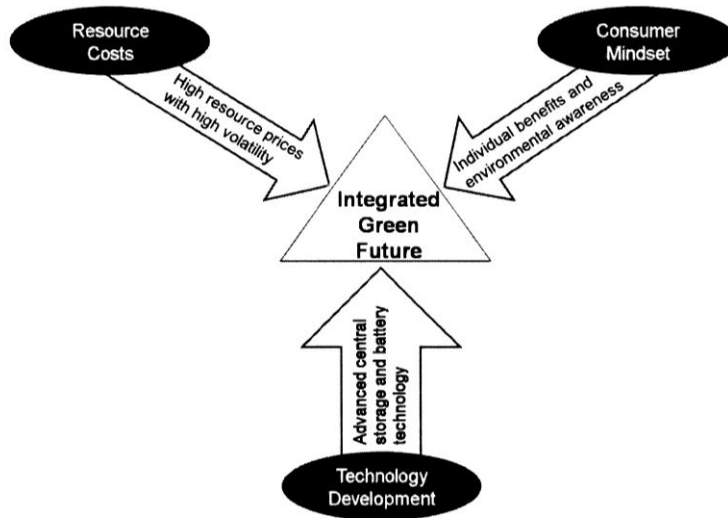


Figure 8.14: Projections of the Key Drivers for the Scenario “Integrated Green Future”

Figure 8: Key drivers for the scenario “Integrated Green Future”

2.17.6 Other

Describe relevant aspects of the scheme that has not been captured in the sections above.

Business model:

The business model is twofold. On the one hand, customers pay a monthly fee for storage. This fee can be either a subscription to a flat rate which allows an unlimited use of the service or a limited storage in different sizes. On the other hand, revenues will be generated through aggregation. Aggregated bundles of generation can be traded on energy markets during peak demand hours (e.g. spot markets, future markets, energy auctions) and can be enhanced throughout the use of different time zones on international energy markets.



Figure 8.18: Revenue streams

Figure 9: Storage Cloud - Revenue Streams (source: Braun B. et al. (2009), p.269)

For the realization of the business model, cooperation with transmission grid operators, with (battery-) maintenance companies and with weather forecast companies (for forecasting the energy production from renewables) will be necessary. Additionally, contracts with insurance companies have to be concluded to insure the service in case of breakdowns or other unanticipated failures.

2.18 Tariff Sheriff

Tariff Sheriff	
Idea reported by	BAUM
Source/based on	Information from the German CDTM and its Trend Reports, ZESMIT project
References	Donat, J. et al (2009)
Related keywords	Products & services

2.18.1 Short description of the scheme [what?]

Summarize briefly the scheme (measures, incentives, to what end shall the tool be developed, for which target group(s); which actor/party takes the initiative, etc.)

The “Tariff Sheriff” is an easy to use web service enabling customers to easily switch tariffs, depending on their preferences and energy consumption patterns. The “Tariff Sheriff” takes care that the customer will always receive the information about the best fitting tariff for their individual consumption patterns.

The service idea is based on the assumptions made in the scenario “Magnificent Many” which is characterized by a polypolistic and heterogenic actor structure on the energy market with many different companies and customers who are willing and used to changing their tariff on a regular basis. The revenue of this service idea is based on the concept of affiliate marketing. All findings presented in this chapter refer to Donat et al. 2009.

The service is an easy to use web interface which is dedicated to convenient users, who want to have the tariff that best matches their consumption behaviour. Therefore, the web-based service offers suggestions based on the energy consumption behaviour of the user. The goal of the “Tariff Sheriff” is to find an energy supplier, contract and tariff that suits the needs of the consumer. In fact, the previously metered energy consumption data is submitted to the “Tariff Sheriff”, which subsequently analyses the data to deduce the consumer’s specific energy consumption model. Taking into account the energy consumption model, users’ preferences and the energy production and energy price forecast, the service finds the best tariff regarding the need of the customer. The service offers an easy change of the tariff and/or supplier based on just a few mouse clicks.

For the analyses of the consumption behaviour, the “Tariff Sheriff” needs access to the installed Smart Meter in order to analyse the load curves and the usage of all installed smart devices. For privacy reasons and to guarantee transparency, the users will decide on the amount and quality of data that will be tracked and used individually. Ideally, the consumer allows the “Tariff Sheriff” to track all information (Smart Meter and Smart Devices) over a long period of time because this will result in the best possible prediction. To further improve the prediction, synchronization with the user’s calendar to analyse times of absence or increased energy usage can be included.

Additionally to this data, a web-based questionnaire for the preferences of the users will be developed. The preference profile contains factors like the importance of renewable energies, environmental friendliness, costs, risks, customer support, comprehensibility of the tariff, and contract duration. These factors can be weighted by the customer.

2.18.2 Objectives [why?]

What is the purpose for developing the scheme? Is there a specific problem that needs solving? Which objectives could be met through the scheme?

The energy prices for each user profile can be forecasted based on the preferences, weather forecasts and forecasts of future developments. Based on this information, the optimal tariff or tariff combinations will be searched by the “Tariff Sheriff”, ranked and listed. Added values of different tariffs are displayed as well. The user can close the contract with the preferred tariff directly on the “Tariff Sheriff” website with just a few clicks. When a tariff is chosen by the user, the system can still permanently review the customer’s behaviour and the emergence of new tariffs which will be proposed to the customer. To obtain the best result, learning techniques (like Support Vector Regression) can be implemented into the service to improve the future prediction of energy consumption according to the energy behaviour of the customer.

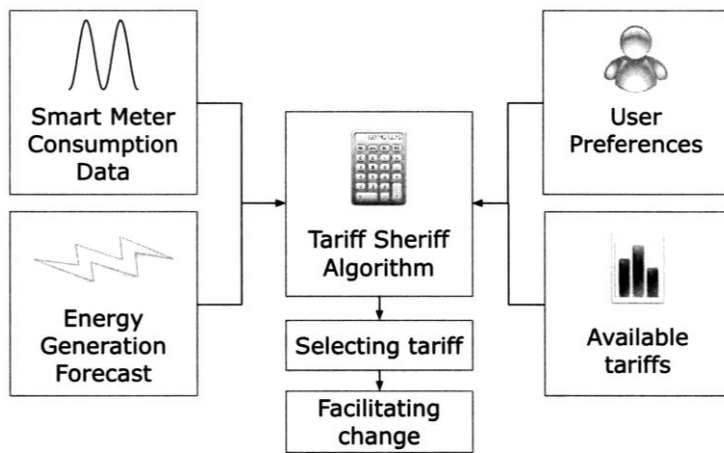


Figure 10.5: Recommendation and selection process

Figure 10: Tariff Sheriff: Recommendation and selection process (Donat et al., 2009, p.357)

Further functionalities that could be added to the described service could be a social network with the topic energy where users can exchange hints and information about electricity consumption. Based on the analysis of energy consumption patterns, advice can be handed out to optimize energy behaviour (e.g. which smart devices would decrease the energy costs). This can cause a rethinking of the energy consumption behaviour.

If the user has changed his tariff, the “Tariff Sheriff” will remain able to analyse the energy consumption behaviour to find a better tariff than the current one.

2.18.3 Actor(s) and target group(s) [who?]

Which actors and stakeholders should be involved in developing the scheme, and for which target group(s)? How will the scheme relate to consumers, customers, citizens?

The tool has already been developed by students and university staff throughout the ZESMIT project. The target group is residential end-users. This is a tool geared especially towards the Smart Consumer who wants to optimize the price he pays for electricity. It renders him an easy opportunity to compare and switch tariff offers. Furthermore, the customer does not only receive the raw information, but also analyses and tips based on his respective consumption patterns.

2.18.4 Relevance for S3C

Explain why the scheme is relevant for SC and how it relates to S3C objectives? Why should it be considered innovative? What is the learning potential for S3C, and which elements are transferable?

The scheme does not only offer data on consumption and information on potentially available tariff structures, but analyses the end-user’s consumption regarding which tariff is the more fitting one. In fact, the end-user can make informed decisions without losing too much comfort or spending considerable amounts of time on decision-making.

2.18.5 Current status and future outlook

Is the scheme already implemented? What experience and results are there so far? Is there research data/evidence available?

For the creation of the scenario, different drivers have been analysed. Certain drivers which have been analysed were the development of the availability of E-Energy⁶ infrastructure, of the political support for E-Energy, of the energy efficiency of devices and processes and of the decentralized power generation. The analysed uncertain drivers were the complexity of markets, customer participation, the

⁶ E-Energy was a demonstration project funded by the German Federal Ministry of Economics and Technology and the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety which aimed to demonstrate test and optimize the usage of ICT-solutions for the interconnectedness and optimization of the future energy supply.

standardization of E-Energy technology, storage technology, availability of customer data and the development of e-mobility.

The driver analysis resulted in three scenarios. The scenario “The Usual Suspects” describes a future which is characterized by extrapolation of the current development with slight modification in the electricity industry. The scenario “Fabulous World of E-Energy” is an optimistic scenario, in which governments and markets dramatically changed the industry. The most likely scenario “Magnificent Many” is based on the assumption that few but relevant evolutionary developments occurred. This results in the need for a bundling function and integrated solutions. The product idea “Tariff Sheriff” is based on this scenario.

The market in the scenario “Magnificent Many” is characterized by very complex energy markets with new market players. Due to new market participants (mainly small companies and other companies from the ICT sector) the competition is likely to be tough. The grid and big power plants are still controlled by the major companies, but other actors act as electricity generators and on the retail market. The dominance of the traditional major suppliers will decrease. The major companies offer simple integrated solutions for rather conservative consumers, but the new resellers offer more flexible energy tariffs and upgrade services (e.g. consulting). In this scenario, the consumers are used to changing their tariffs and are willing to change their consumption behaviour.

2.18.6 Other

Describe relevant aspects of the scheme that has not been captured in the sections above.

Business model:

The “Tariff Sheriff” is an interface between customers and utilities with the aim to be “smart, simple and unbiased”⁷. Customers are end-users who are active and participatory, which will be the majority in the described scenario. These end-users are either price sensitive, environmentally aware if they use the service or in a best case both

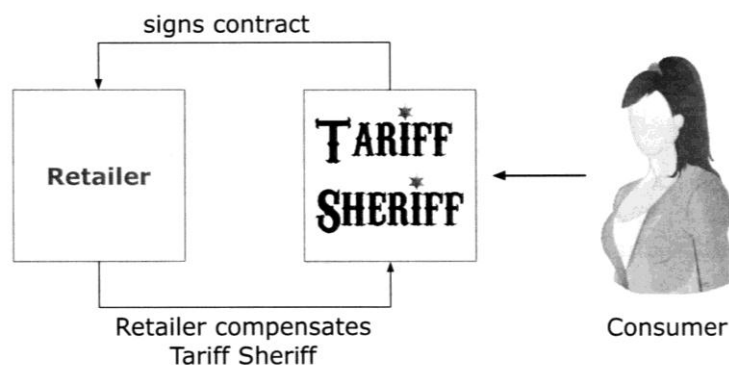


Figure 10.11: Affiliate marketing

Figure 11: Tariff Sheriff - Affiliate marketing (source: Donat et al., 2009, p.365)

But the service will not be paid by the end-users, but by the utilities and energy retailers which have a platform for the marketing of their tariffs. Therefore, the business is based on affiliate marketing. The “Tariff Sheriff” will become the independent affiliate of many energy retailers. Suppliers have to pay an amount of money for every contract with a customer (costs per action-approach). Additionally, the suppliers have to pay a fixed monthly fee to be listed on the “Tariff Sheriff” website, because suppliers in a market with many participants have a high interest to be found. Especially new companies who do not have a big budget for marketing will be very interested in this service.

⁷ Donat et al., 2009, p.364

2.19 Virtual Prosumer

Virtual Prosumer	
Idea reported by	BAUM
Source/based on	Information from the German CDTM and its Trend Reports, ZESMIT project
References	Binder, F. et al (2009)
Related keywords	Products & services, new market structures

2.19.1 Short description of the scheme [what?]

Summarize briefly the scheme (measures, incentives, to what end shall the tool be developed, for which target group(s); which actor/party takes the initiative, etc.)

The service idea “Virtual Prosumer” is assumed based on scenario construction. In the scenario “Interconnected Swarms”, retailing locally generated electricity is not profitable anymore. The service idea “Virtual Prosumer” reacts to this circumstance. It is a virtual electricity exchange platform, where consumers and prosumers of the same distribution grid are organized as one Virtual Prosumer. Within the distribution grid, the customers of the “Virtual Prosumer” are able to share and store their electricity. Every household is equipped with a gateway and a Smart Meter which is capable to follow up on consumption and generation of energy in the household and communicate the metered data to third parties. Smart appliances within the houses can be controlled by the gateway, which can react in case of excess or lack of electricity production. The control of the smart devices by the gateway is based on the user’s preferences.

Different Virtual Prosumers (which means different interconnected distribution grids) are interconnected and able to act as a trader of electricity on the European level. Furthermore, they can share electricity between different Virtual Prosumers. The three levels of a Virtual Prosumer are:

- “price adjustment to the outside by trading with other prosumer clouds and/or at the NEEEX⁸
- Low real-time prices inside the prosumer clouds promoting matching
- In-house matching through automated gateways in control of relevant smart devices in a building.”⁹

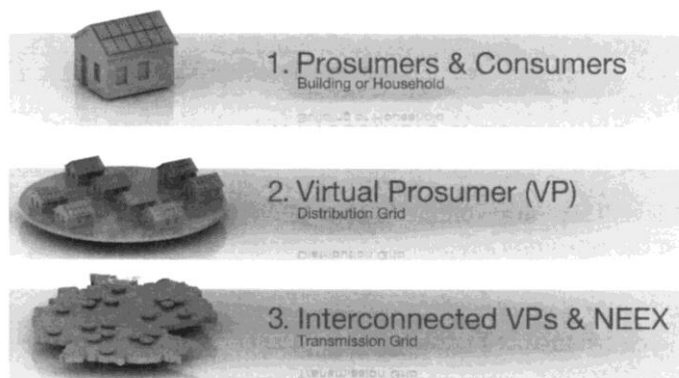


Figure 9.12: Three levels of clustering

Figure 12: Virtual Prosumer – levels of clustering (source: Binder et al. (2009), p. 309)

The “Virtual prosumer” is a reaction to different customer needs, whereby two kinds of consumers have to be distinguished. On the one hand, the producers of electricity who want to benefit financially from their produced energy. Because energy is mainly produced from volatile renewable energy sources, the organization within a Virtual Prosumers makes it possible to act on the European/global market. On the

⁸ NEEEX is the „New European Energy Exchange“, a spot market on the European level, which is part of the scenario “Interconnected Swarms”.

⁹ Binder et al. (2009), p. 306

other hand, big and flexible consumers of electricity can profit from the Virtual Prosumer. They can save money by real time pricing, can buy energy at a lower price than on the market and profit from devices which can react on price changes and forecasting. Furthermore, investing in storage or production of electricity will be rewarded within the Virtual Prosumer. Electricity can be bought relying on different pulsing options, depending on the customer's preferences. Critical values can be set such as e.g. for buying for the next hour or buying on a minute-to-minute basis. The need of customers to be an active market participant can be fulfilled and customers will get real time information about electricity consumption and pricing.

The system of the Virtual prosumer calculates prices for all three levels. Additional services are provided by the gateways. They can recognise consumption patterns, the smart devices can be controlled and their usage monitored for consumption forecasting. The trading itself is automated and will be carried out by the hardware for the consumers based on pre-programmed settings, which can be changed.

Regarding the forecasting, the Virtual Prosumer analyses the users' behavioural patterns and combines this data with weather forecasts. Based on this information, the consumer can properly react to price changes. The price will be calculated based on the forecast for different periods of time (e.g. 1 minute or 30 minute intervals) and participants can decide to take action (this process is automated, but the customer have control over the settings).

A further additional service is the matching, which is an automated process within one Virtual Prosumer that finds matching consumers and producers of electricity within the same distribution grid.

2.19.2 Objectives [why?]

What is the purpose for developing the scheme? Is there a specific problem that needs solving? Which objectives could be met through the scheme?

The organisation in a "Virtual Prosumer" offers customers the possibility to trade their electricity when needed, based on their own preferences and forecasts. Despite the high complexity of the electricity and trading system, customers can be active market participants. Consumers of electricity are enabled to consume electricity constantly and with a high security of supply. Furthermore, they can act as a buffer by the automated regulation of the energy consumption of their smart devices.

2.19.3 Actor(s) and target group(s) [who?]

Which actors and stakeholders should be involved in developing the scheme, and for which target group(s)? How will the scheme relate to consumers, customers, citizens?

The tool has already been developed by students and university staff throughout the ZESMIT project. The target group is residential end users in general and prosumers in particular. This tool is geared towards the Smart Customer and/or Smart Citizen of S3C, since it relies on the purchasing of costly equipment that takes years to amortize, so that a strong motivation deriving from general awareness and/or a tendency to become energy autonomous are required.

2.19.4 Relevance for S3C

Explain why the scheme is relevant for SC and how it relates to S3C objectives? Why should it be considered innovative? What is the learning potential for S3C, and which elements are transferable?

The scheme sheds light on how a Prosumer can be incorporated into Smart Energy structures and under which circumstances it could work.

2.19.5 Current status and future outlook

Is the scheme already implemented? What experience and results are there so far? Is there research data/evidence available?

For the development of the scenarios, different drivers have been analysed. Drivers with a certain developments were the liberalization of the electricity sector, the development of foreign trade policies, the dependency on energy sources and the development of the social and demographic structure. Uncertain drivers which have been analysed were the development of subsidies and feed-in tariffs, of big players and the willingness to invest. Uncertain drivers which have been chosen as key drivers for the scenario construction were the development of the impact of ICT, the power supply infrastructure and the consumer market participation.

Based on these drivers, three scenarios have been designed. The scenario "Giants Amongst Each Other" is characterized by market places with only few major utilities and bidirectional trade (long term

contracts). The scenario “Beehive” is characterized by a large number of market participants, a big international exchange market and a polypolistic actor structure.

The scenario, which is the basis for the service idea “Virtual Prosumer”, is called “Interconnected Swarms”. This scenario is mainly characterized by a large share of prosumers, advanced technology, highly diversified electricity markets, no guaranteed feed-in for electricity from RES and a high importance of storage technologies.

Due to the further fostered liberalization of the energy market, which allows companies to act in only one part of the value chain, many new actors emerged on the market. On the regional scale, in the distribution grids micro markets are installed which are linked to each other and to an exchange market on the European level. The market actor structure made a shift from big market players to small companies that offer specialized services, like e.g. leasing of renewable energy and storage facilities. This further resulted in the emergence of many new markets and micro markets. All transactions are made in real time.

The end of guaranteed feed in for renewables and the decentralized generation of electricity and the high importance of privacy gave rise to the need for storage, which plays an important role in this scenario. Many private and industrial consumers rely on their own storage solutions (different technological solutions, like e.g. batteries, hydrogen ...).

ICT is highly sophisticated and controls generation, distribution and consumption of electricity. Smart Meters and gateways are installed in most buildings, household devices interact with each other through open standards and increased efficiency led to a decline in overall energy consumption.

In result, the grid and all its services have become very complex, which makes them difficult to understand for the end-user.

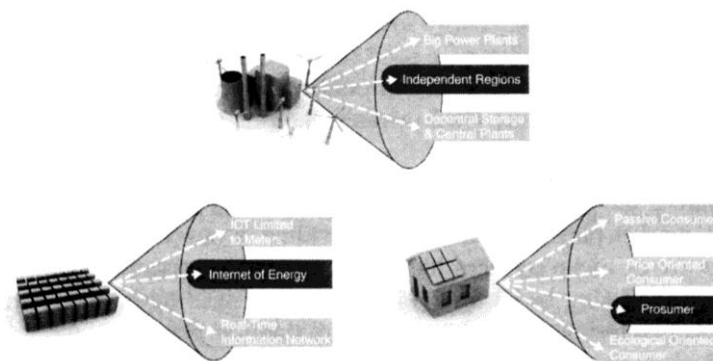


Figure 9.10: Interconnected Swarms key drivers and projections

Figure 13: key drivers in the scenario “Interconnected Swarms” (Binder et al. (2009), p. 300)

2.19.6 Other

Describe relevant aspects of the scheme that has not been captured in the sections above.

Business model:

In the business model for the Virtual Prosumer, the revenue is made through a margin, the VP-service provider adds to each energy transfer such as e.g., buying from the European energy exchange or transmission within the VP or from one VP to another.

Partnerships and cooperation with hardware-suppliers for the smart devices controlled by the gateway will have to be formed. Further cooperation can be entertained with landlords or housing associations who own many houses and have a high energy supply (e.g. by photovoltaic installed on the roofs). By means of these agreements, all tenants of the landlord will become members of the VP.

3. Analysis

The initial step of the analysis of the innovative schemes presented in task 3.3 is a cluster analysis based on the nine research themes/challenges formulated in S3C WP3, where all schemes are clustered in groups according to which of these challenges they aim to address. The results are shown in the table below.

S3C challenge	Research question	Innovative schemes relating to challenge
1. Understanding the target group(s)	Which instruments or approaches contribute to achieving better understanding of the needs and desires of target groups?	2.6, 2.7, 2.12
2. Products & services	How / in what way can innovative products and services contribute to fostering smart energy behaviour?	2.1, 2.2, 2.3, 2.4, 2.6, 2.8, 2.9, 2.10, 2.11, 2.13, 2.17, 2.18, 2.19
3. Incentives & pricing schemes	Which (monetary or non-monetary) incentives and pricing schemes contribute to fostering smart energy behaviour?	2.5, 2.10, 2.14
4. End-user feedback (system communication)	What feedback information and which feedback channels contribute to fostering smart energy behaviour?	2.1, 2.4, 2.9, 2.13, 2.16
5. Project communication	Which communication channels, information and marketing techniques contribute to recruitment and engagement of end users in smart energy projects?	2.6, 2.7, 2.12
6. Cooperation between stakeholders	Does involvement of non-energy stakeholders contribute to end user engagement and smart energy behaviour?	-
7. Bottom-up support	Which instruments or approaches contribute to facilitating end user empowerment? (from consumer to customer and/or citizen)	2.6, 2.7, 2.12
8. New market structures	Which features of the interaction between end-users and energy market structures contribute to end user engagement and smart energy behaviour?	2.10, 2.15, 2.17, 2.19
9. Scalability / replicability	Which issues hamper and/or facilitate up scaling or replication of smart energy projects?	-

The second step of the analysis targets the cluster of innovative schemes within each challenge. The aim is to identify common elements in these groups of innovative ideas, which could provide indications and examples to what lies in the future of the S3C family of projects. The results of this analysis are presented in the following section.

3.1 Understanding the target groups

Research questions related to challenge 1, Understanding the target groups: Which instruments or approaches contribute to achieving better understanding of the needs and desires of target groups? The innovative schemes addressing this challenge are: 2.6 *Energy blogger*, 2.7 *Energy clubs/associations* and 2.12 *Local ambassadors for energy companies*. These schemes have the following individual potentials for fostering smart energy behaviour through understanding the target groups:

- The *Energy blogger* focus on lifestyle issues, design, fashion and health, or similar issues in line with the interest of the target groups. Many young people lack interest in energy-related issues and actions while on the other hand there is a widespread interest in lifestyle issues, as well as in health, design and fashion, and there are many examples of successful young bloggers with a large number of followers. Through understanding what the target groups' interests are and addressing them in an appealing way, the energy blogger has the potential to be a powerful role-model for smarter energy behaviour. The blogger is aimed at specific target groups and introduces energy in small portions and in a way that has shown to engage specific target groups, thereby also considering and understanding the specific target group.
- *Energy clubs/associations* gather energy interested end-users who want to exchange ideas and meet others with a common interest energy issues. By cultivating other shared interests besides energy strengthen the energy club as a social meeting point. The club/association could for example include other areas, such as other environmental issues, culture or sports to both attract potential members and to strengthen the group feeling. This scheme has a high level of understanding the target groups, as the clubs are entirely made up from end-users. By making the energy club an attractive meeting point the engagement, knowledge and willingness to apply smart energy behaviour will increase.
- The scheme *Local ambassadors for energy companies* aims at establishing a more personal and close contact to the customers, by supporting them within their own neighbourhood or area and on their conditions. This scheme can potentially be a vital measure for companies to get to know and understand their target groups (if the ambassador also reports back to the company, that is).

Discussion

There are some similarities and differences between the ideas described above. All three of them are based on the interests, habits and everyday lives of the end users rather than on pure energy issues; they focus reaching the end-users in the everyday life and to do it on the end user's own conditions. All three measures are directed mainly at individuals strongly driven by their lifestyle routines, in the S3C context the smart *consumer*. On the other hand, they all relate to the creation of a community feeling, i.e. they all support a popular movement towards energy awareness without pushing energy issues too hard. In this way they all relate to the smart *citizen*.

The *Local ambassador for energy companies* and the *Energy blogger* both reduce the gap between the consumer and the energy technology and/or energy companies by constituting the links between them and being a person supplying the end user with knowledge, competence and presence. The main difference between the two schemes is that the ambassador, on the one hand, is biased (sponsored by a company or similar) while the independence of a blogger is crucial to be trustworthy.

Just like the followers of the *Energy blogger*, the members of *Energy clubs/associations* are tied together by a common interest which is not energy. They are both built on a common interest in an area or social interactions, opening up for discussions and information on different energy issues now and then.

3.2 Products and services

Research questions related to challenge 2, Products and services: How / in what way can innovative products and services contribute to fostering smart energy behaviour? The innovative schemes addressing this challenge are: 2.1 *App for individualized load-curve based energy consulting services*, 2.2 *Consumption notification programs*, 2.3 *ECOoperation*, 2.4 *EEnergy OS*, 2.6 *Energy blogger*, 2.8 *Energy management systems balancing energy consumption and generation for consumers*, 2.9 *Energy recorder*, 2.10 *Flexibility management with closed contracts*, 2.11 *ICT “extended solutions*, 2.13 *Merging Home automation and energy management*, 2.17 *Storage Cloud*, 2.18 *Tariff Sheriff* and 2.19 *Virtual Prosumer*. These schemes have the following individual potentials for fostering smart energy behaviour through products and services:

- The *App for individualized load-curve based energy consulting services* provides feedback on energy use to the end-user. The innovative approach of the scheme lies in the combination of several functionalities, and that the scheme individualizes them for the respective end-user. It enables better informed decisions and thereby facilitates smarter energy behaviour.
- The *Consumption notification programs* offers the electricity supplier and distributor to communicate with the end-user in case of expected or un-expected events where actions are desired or even required to ensure safety of supply. Similar type of communication is already in use, but the information channels – text messages to mobile phones or e-mail – are new.
- *ECOoperation* is a tool for companies to predict their load curves and optimize energy use based on supply and demand, in a network of medium-sized companies. This tool combines traditional energy management and energy efficiency measures and is inspiring to help foster smart energy behaviour due to the combination of not only monetary incentives deriving from energy efficiency and load shifting measures, but also the community efforts that are incorporated in the scheme.
- *Eenergy OS* is a new service offering one interface for all energy appliances and sources in the home, enhances the role of the end-user and puts him in a position where he can actively take part in the energy market. Furthermore, it increases the comfort of the end-user, as all household appliances can be controlled in a central system.
- The *Energy blogger* attracts target groups that traditionally have a low or non-existing interest in energy issues. Blogs with energy focus already exist. Even though many of them aim at presenting and explaining energy issues in an easily understandable way, they tend to attract people that are already interested. The innovative part of this measure is to not explicitly start an energy blog, but a lifestyle blog, where energy behaviour is only presented as one part of a lifestyle. This has the potential to attract target groups that have not cared about energy at all so far, and the idea to use unexpected role models focused on lifestyle, health and design in this way is new.
- The *Energy management systems balancing energy consumption and generation for consumers* promotes smart energy behaviour by supporting owners of distributed energy resource in optimizing their own use of the generated electricity, heading for autonomy. The system directs the generated electricity to the appropriate load or storage unit. System effects caused by mismatch between production in distributed electricity plants and residential electricity use can thereby be reduced. The system enables end-users to become (even autonomous) market partners and the purchasing of such equipment is costly and requires a high awareness and interest for energy related topics.
- *Energy recorder* is a device that measures the individual energy use by logging activities during the day. Gaming, comparisons and publications on social media are vital elements in the scheme that can encourage users to become more aware of their energy use and facilitate energy smart

behaviour. The idea is based on other existing popular apps to record and share physical activities (Runkeeper, Strava etc.) and is directed to end users triggered by gaming and performance/points counting. In other words, the innovative element lies in the application of the tool, not the tool itself.

- In the service *Flexibility management with closed contracts* the end user offers the energy provider its consumption flexibility by a closed contract where both price, amount and profile are defined in advance. The closed contract idea, where all energy consumption parameters are set in advance, is the innovative service part of this scheme. It offers the energy provider a predictable load, while the (residential or SME) end-user becomes an active part in this by its detailed offer.
- The scheme *ICT “extended” solutions* is a software application through which end users’ participation is increased. It is adapted to the needs of people with specific health difficulties as it can be used from a touch screen terminal (without keyboard or mouse), a tablet or on a classical laptop and its intuitive user interface has been especially designed to be easy to use by people who are less or even not at all familiar with computers. Although the tool has so far been used in telemedicine issues, the learned lessons and the inferred best practices as regards to human interaction with technologies can also be applied in the energy related contexts.
- The *Merging home automation and energy management* is a new combined service providing residential end-users several different services (security, energy, fire protection etc.) in one. Energy services are only one part of the solution, and other services may be more attractive to the common user. The services may be interconnected to achieve synergies, for example systems forcing energy consuming devices to be turned off before leaving home, and thereby support energy smart behaviour. The scheme is related to the Smart Home movement, which is seen as one of the potential drivers for the introduction of Smart Grids, as it enhances the comfort the end-users, who do not have to deal with load-shifting and energy efficiency processes themselves, as they are automated. Furthermore, it links the “low interest” topics to other topics (such as security management) which are considered more interesting by many end-users.
- The *Storage cloud* aims at minimizing the energy feed-in to the grid from distributed renewable energy sources to increase the benefit for the end-user. This is done by offering residential and industrial prosumers to rent virtual storage capacity, and thereby avoid high investment and maintenance costs in individual storages. The storage provider will be trading the electricity on the market for revenue, acting as an aggregator. The idea of aggregators is not new, while the combination with a storage solution is. The storage cloud promotes a higher degree of “autonomy”. The scheme sheds light on how a Prosumer can be incorporated into Smart Energy structures and under which circumstances it could work.
- The *Tariff Sheriff* is a web service that provides users with information on the optimal tariff compared to the user’s electricity use profile, and also makes it easy to switch between different tariffs. The new service will not promote smarter energy behaviour, since the proposed tariff will always be optimized based on the current load curve. However, the service will make it easier to become active on the market, changing tariffs and contracts, and switch between different electricity suppliers. This has so far often been experienced as complicated by people in general. The scheme does not only offer data on consumption and information on potentially available tariff structures, but analyses the end-user’s consumption regarding which tariff is the more fitting one. In fact, the end-user can make informed decisions without losing too much comfort or spending considerable amounts of time on decision-making.
- The *Virtual prosumer* is a service to organize producers and users within the same distribution grid. The service assumes that feed-in of self-produced electricity is not profitable. Instead, electricity is shared or jointly traded within the virtual prosumer. By this service, small actors can be active on a global market, i.e. opening up for new market roles in collaboration with other

actors. The scheme provides insight to how a Prosumer can be incorporated into Smart Energy structures and under which circumstances it could work.

Discussion

The cluster of innovative schemes incorporating products and services is a diverse group, with a variety of devices and services with very different functionalities. Therefore, drawing conclusions on similar traits in these schemes is a complex task which might not bring much added value to the individual descriptions above. However, some traits that can be seen in a few of these schemes can be mentioned. There appears to be quite a number of products and services aiming to engage end users who are normally not (primarily) interested in energy. Both the *Energy blogger* and the *Energy recorder* are targeting end users who would not be interested in energy issues, but who are triggered by lifestyle issues and performance respectively. The *app for individualized load-curve based energy consulting services* can also be placed in this category, since it will be most helpful to end-users with limited knowledge of expected lifetimes and function of appliances. The same reasoning applies to the *Merging Home automation and energy management* scheme, which is aimed at those end-users who would rather be interested in buying and installing new home services unrelated to energy, but receiving energy-smart solutions along with the other systems. Also the *E-EnergyOS* will reduce the complexity of Smart Homes and makes them accessible for people who are not familiar with technology or electricity tariffs. Further, the *ECOoperation* is directed to companies not into energy (who “focus on their core business”) and thus holds similar traits. However, the *Energy management systems balancing energy consumption and generation for consumers* differs from the above group in the sense that it is directed to consumers with a deep interest in energy issues, even those striving for energy self-sufficiency.

Several schemes (the *Storage cloud* and the *Virtual prosumer*) are services promoting collaboration between different actors in order to empower them into a stronger position in the future energy market.

3.3 Incentives & Pricing schemes

Research questions related to challenge 3, Incentives & pricing schemes are: Which (monetary or non-monetary) incentives and pricing schemes contribute to fostering smart energy behaviour? The innovative schemes addressing this challenge are: *2.5 End-user behaviour classification*, *2.10 Flexibility management with closed contracts* and *2.13 Pre-paid electricity account*. These schemes have the following individual potentials for fostering smart energy behaviour through incentives & pricing schemes:

- The *End-user behaviour classification* has an approach that motivates the end user to strive towards changed energy behaviour; the end-user is stimulated to shift from one electricity package to another in a stepwise approach. The incentives are different electricity packages, designed by the energy provider. The packaged offers are based on the individual end-user behaviour and presented in an appealing way. An end-user is offered a more efficient and less expensive package suiting their actual consumption patterns, which provides economic incentives to the end-users to make a change. Hints and conditions from the energy provider is another motivation for changing behaviour and to enter into another package. The different classes will stimulate end-users into taking larger measures to gain next class incentives, and the pre-defined packages will simplify the selection process for end-users.
- The scheme *Flexibility management with closed contracts* can make end-users more aware of their electricity consumption and may stimulate smart energy behaviour through a very high level of end-user engagement. The contracts are set before the actual consumption takes place, specifying the price, the consumption patterns and the volume of electricity traded between the energy provider and the end-user. This, however, requires an end-user that has some knowledge about his/her electricity consumption and that does not feel hindered by complex planning.
- The *Pre-paid electricity account* can be said to foster smart energy behaviour through stimulating the end-users to pay more attention to its electricity consumption patterns and costs. The incentive for the end-users to change their consumption patterns lies in the possible economic gains - if the consumption is distributed so that more electricity is used in less expensive periods.

Discussion

Some common elements can be found in these schemes. All three schemes are motivating end-users through economic incentives, and not through other types of incentives. Additionally, all three schemes have traits of individualization – they are in different ways tailored to the individual consumption of end-users. With the *Pre-paid electricity account*, consumption is entirely determined by the wishes of the end-user given that there is money in the pot, which implies a very flexible use of energy for the end-users without binding agreements or regular payments. The *End-user behaviour classification* designs and offers tailored packages based on the individual consumption from each end-user. In the scheme *Flexibility management with closed contracts*, end-users are designing the contracts themselves according to their individual needs and patterns for energy consumption.

Two of the schemes, the *Pre-paid electricity account* and the *Flexibility management with closed contracts* have both taken inspiration from the telecommunication sector where closed contracts and pre-paid accounts have been used for a long time. These two schemes also have another characteristic in common: the patterns of activity from end-users. End-users are required to take actions in order to gain fully from these schemes. This puts demands on rather proactive types of end-users. The timing of the actions is specific as they must take place before the actual consumption is occurring. Thus, the motivation for end-users is probably based on a strong interest of being in control of their own costs and reducing risks. In contrary, the *End-user behaviour classification* allows the end-user to be relatively passive and react to signals and offers from the energy provider.

Regarding the complexity of the schemes, the *Flexibility management with closed contracts* and the *End-user behaviour classification* are both quite complex implying that end-users must have a strong engagement and understanding of their consumption as well as what is asked from them and why. The *Pre-paid electricity account* has a rather more direct and simple design, which would probably attract another type of end-user.

3.4 End-user feedback (system communication)

Research questions related to challenge 4, End-user feedback are: What feedback information and which feedback channels contribute to fostering smart energy behaviour? The innovative schemes addressing this challenge are: *2.1 App for individualized load-curve based energy consulting services*, *2.4 EEnergy OS*, *2.9 Energy recorder*, *2.13 Merging home automation and energy management* and *2.16 Social comparison on aggregated levels*. These schemes have the following individual potentials for fostering smart energy behaviour through end-user feedback:

- The feedback of the *App for individualized load-curve based energy consulting services* provides easy-to-grasp, easy-to-access information for end-users. The simplicity could potentially be encouraging the engagement of some end-users. Additionally, end-users could be motivated by social comparisons which are important elements in this app.
- *EEnergyOS* is a display that can visualize extensive information about current and historic energy consumption for the whole household and individual appliances as well as the production source of the used energy. The display provides visualizations in different customizable ways, giving the end-users the opportunity to choose which way they prefer to see it.
- The *Energy recorder* measures the energy performance of an individual end-user, facilitating comparisons, games and visualization of energy use. It holds a social dimension through a connection to social media, enabling comparisons with other people and positive feedback from other end-users. Thus, early adapters who want to show their good habits and behaviour to others can potentially be stimulated by such a tool. The scheme allows elements of competition.
- The *Merging home automation and energy management* scheme provides feedback by a type of alerts sent to end-users, reminding them of appliances that are left on through hindering the person to lock the house when exiting. Feedback is thereby direct and with a simple design, without complex information.
- The *Social comparison on aggregated levels* makes use of scale for visualizing the effects of energy use among large groups of end-users, such as neighbourhoods or communities. It incorporates a social dimension of end-users being part of a group and belonging to a context, which can provide a motivation to engage and change behaviour. Through adding an element of competition between different areas, additional motivators are brought into the scheme. It could support and foster smart energy behaviour through the combination of social comparisons on a large scale, competitive ingredients and the community and individual efforts that are incorporated in the scheme. The public display of results could trigger smarter behaviour through the materialization of “myself/us in the eyes of others”, providing a will to perform well. Moreover, the visualization of the effects from energy use can be presented through using easy-to-grasp symbols and different indicators such as economic, environmental or other effects. Thus, the symbols would appeal to several motivations in end-users.

Discussion

From the schemes described above, all but the *Merging home automation and energy management* offer different types of visualization of energy consumption. One characteristic is the scale of which the visualization is done – from the individual person to large groups of end-users.

Three out of five schemes address the social dimension of end-user engagement; the *App for individualized load-curve based energy consulting services*, the *Energy recorder* and the *Social comparison on aggregated levels* the through providing social comparisons between end-users, even if the comparisons are done on different scales.

In the *Energy recorder* and the *Social comparison on aggregated levels*, an element of competition is added. End-users being enticed by gaming and performance can become engaged through monitoring devices giving feedback on their energy performance. Especially when addressing end-users with a low interest in energy efficiency, sustainability concerns and flexibility in a traditional sense, these schemes could provide a possible approach. Performance-oriented people should be stimulated by such schemes.

All of the schemes appear to be striving for simplicity – easy to understand, easy to access and easy to use. The content of the feedback information is complex in some but very basic in others.

3.5 Project Communication

Research questions related to challenge 5, Project communication are: Which communication channels, information and marketing techniques contribute to recruitment and engagement of end users in smart energy projects? The innovative schemes addressing this challenge are: *2.6 Energy blogger*, *2.7 Energy clubs/associations* and *2.12 Local ambassadors for energy companies*. These schemes have the following individual potentials for fostering smart energy behaviour through project communication:

- The *Energy blogger* provides indirect, embedded information and communication about energy matters, tailored to a specific target group. By supplying energy information in an appealing manner, and in small portions, by a person with a desirable lifestyle, behavioural changes may be achieved within the group of blog followers. The blogger communicates and spreads information about smart energy behaviour in a fun and easy-going manner. The end-user should be engaged in playful and value-added approaches, as the low-interest topic electricity is difficult for end-users to relate to and become engaged in. Many young people lack interest in energy-related issues and actions while on the other hand there is a widespread interest in lifestyle issues, as well as in health, design and fashion, and there are many examples of successful young bloggers with a large number of followers. The interest in energy might be captured by using unexpected role models, such as the blogger. Transparency is crucial since the end-user has to trust the blogger in order to take their advice seriously.
- *Energy clubs/associations* is an information portal as well as a meeting and knowledge sharing facility, which can possibly also have a broader field of interest and include other areas of interest such as sports, culture etc. The scheme adds a social dimension and provides a possibility for end-users to contribute to other peoples' knowledge increase in energy related matters in an open environment, which can be a powerful driving force. It has a potential to facilitate increased energy awareness through social networking and by making various energy solutions or options more visible for its members. This could for instance be the case for end-users having a low confidence for the energy market and industry.
- The scheme *Local ambassadors for energy companies* enables energy companies to reach out to end-users and connect to them in personal and close relations. The energy company identifies ambassadors who can represent the energy company in their own neighbourhood, and provide the ambassadors with information, tools and material for being a neighbourhood activator. The ambassador can help to remove the feeling that large energy companies only have logos, not faces, and will support their neighbours with information and advice. Thus, end-user attitude changes can be stimulated as the knowledge on energy issues will be raised, and the ambassador will also help to establish trust and loyalty towards the company through the local connection. This phenomenon is often seen in smaller energy companies with a higher grade of personal relations to the end-users.

Discussion

All of the schemes described above contain elements of continuous delivery of information and continuous contact with end-users in all the schemes. Transparency and trust are important components in communication, to avoid that end-users feel misled.

In three of the schemes - the *Local ambassadors for energy companies*, the *Energy blogger* and the *Energy clubs/associations* – information is provided through human interaction from “ordinary people” to reach out to end-users and to facilitate end-user engagement.

The local level seems to be important in two of the schemes; *Energy clubs/associations* and *Local ambassadors for energy companies* both emphasize involvement of end-users alongside close and personal relations.

The use of unexpected, new communication channels and/or role models is seen in the schemes *Energy blogger* and *Energy clubs/associations*. This might draw interest for energy issues from target groups that don't have a large interest in energy today, such as the young generation or other people. The information content in these channels can be related to non-energy topics, which might also contribute to attracting

end-users who would not be interested in pure energy issues. Additionally, end-users having a low confidence in the energy industry might be attracted to channels independent of the energy companies, and these two schemes might then provide a way forward. Moreover, the end-users in these schemes must be active to receive information, communicate and participate; they have to go to the blog, join the club or make contact with the ambassador (depending on the behaviour of the ambassador, of course). These three schemes also address the social networking dimension and can enable contact surfaces between end-users.

3.6 Cooperation between stakeholders

There are no innovative schemes addressing this challenge.

3.7 Bottom-up support

Research questions related to challenge 7, Bottom-up support are: Which instruments or approaches contribute to facilitating end user empowerment? (from consumer to customer and/or citizen). The innovative schemes addressing this challenge are: 2.6 *Energy blogger*, 2.7 *Energy clubs/associations*, and 2.12 *Local ambassadors for energy companies*. These schemes have the following individual potentials for fostering smart energy behaviour through bottom-up support:

- The scheme *Energy blogger* addresses end-users having a very low knowledge about energy and their own energy consumption. By introducing energy as a part of other non-energy related issues, the awareness and knowledge of the addressed end-users can increase, and thereby also the possibility for these end-users to engage.
- *Energy clubs/associations* can give bottom-up support by gathering energy interested people so that they can exchange ideas and thoughts concerning energy usage. By using a social network such as a club/association, possible solutions and means can be made visible for a broader audience.
- The *Local ambassadors for energy companies* scheme emphasizes on the communication with end-users through local ambassadors supporting end-users in energy related issues. By this approach, the ambassadors contribute to the end-users possibilities to engage, increase their own knowledge, and to take control over their own energy consumption. By supporting and pointing out possible solutions or action, the ambassadors can thereby empower end-users.

Discussion

All three schemes described above address the social dimension in end-user empowerment. They all use human interaction (in person or through blogs) as the main tool to reach out to end-users and to facilitate end-user engagement. Focus is on end-users either not being interested in energy, or not trusting the energy companies. In the case of empowering end-users having a low interest in energy, channels not focusing on energy usage are proposed in the schemes above (ambassadors or blogs). Concerning end-users having a low confidence in the energy industry, channels independent of the energy companies can be a way forward (such as clubs or associations).

3.8 New market structures

Research questions related to challenge 8, New market structures are: Which features of the interaction between end-users and energy market structures contribute to end user engagement and smart energy behaviour? The innovative schemes addressing this challenge are: 2.10 *Flexibility management*, 2.15 *Real-time market for regulating power*, 2.17 *Storage cloud* and 2.19 *Virtual Prosumer*. These schemes have the following individual potentials for fostering smart energy behaviour through new market structures:

- The *Flexibility management* scheme includes a service provider acting on the market as an aggregator. The scheme mainly deals with the interaction with the end-users through a negotiation phase leading to a closed contract concerning the energy delivery to the end-user. Hence, the scheme itself does not imply a new market structure, but the scheme requires that aggregators and service providers are allowed to act on the electricity market.
- The *Real-time market for regulating power* scheme includes a new market function for providing real-time balancing power. End-users do not act themselves, but through a load balance responsible. Hence, the scheme provides a market place for new actors acting on behalf of the end-users rather than addressing the end-users directly. In that sense, the scheme constitutes an infrastructure for end-user involvement.
- The scheme *Storage cloud* provides virtual storage for prosumers, and can also act as an aggregator on the energy market. Hence, the scheme itself is not a new market structure, but the scheme requires the electricity market to be open to aggregators.
- The scheme *Virtual Prosumer* is based on local electricity markets where local production can be traded within the local grid (on distribution level), and with the possibility to also trade with an external market on a national or international level. This constitutes a new market structure and design, facilitating local trading based on the prosumers own preferences and forecasts.

Discussion

The schemes *Storage cloud* and *Flexibility management* do not propose new market structures, but the need for opening up the market for new actors such as aggregators are apparent for actual implementation of these schemes.

Both the schemes *Real-time market for regulating power* and *Virtual Prosumer* addresses the issue of real-time balancing using the demand side. In the case of *Real-time market for regulating power* this is the focus, while in *Virtual Prosumer* this is facilitated by the implementation of the scheme. The main differences between these two schemes is that *Real-time market for regulating power* provides a new market place within the existing market structure, while *Virtual Prosumer* suggests a new distributed market structure.

3.9 Scalability/replicability

There are no innovative schemes addressing this challenge.

3.10 Relation to the end user roles of S3C

The aim of S3C is to foster ‘smart’ energy behaviour of European households and SMEs via end-users’ active participation and to contribute to successful, long-term end-user engagement projects and programs. However, our differences as human beings imply that a variety of engagement strategies on different levels are required. Therefore, the S3C project has defined three roles of end-users in the context of smart grids, with the goal of stimulating cooperation between them and the future energy system: Consumer, Customer and Citizen. These roles are defined to illustrate the changing position of the end-users in the future energy system. Moving from passive consumers, we see a trend towards more active participation of end-users through e.g. local generation, more prominent market positions, and energy communities. In brief, the Smart Consumer wants to reduce energy consumption and costs and change his lifestyle routines, while the Smart Customer wants to become a prosumer, thereby consuming energy as well as providing energy services and consumption flexibility. The Smart Citizen wants to become part of a ‘smart energy community’ and help ensure quality of supply and environment preservation.

The innovative schemes described in this report are aiming to engage end-users and can also be categorized from how they relate to the end-user roles according the table below.

S3C end-user role	Description	Innovative schemes relating to end-user role
Smart Consumer	Wants to reduce energy consumption and costs and change his lifestyle routines	2.1, 2.2, 2.3, 2.5, 2.6, 2.9, 2.10, 2.12, 2.14, 2.16, 2.18, 2.19
Smart Customer	Wants to become a prosumer, thereby consuming energy as well as providing energy services and consumption flexibility	2.1, 2.3, 2.4, 2.5, 2.8, 2.10, 2.13, 2.15, 2.17, 2.19
Smart Citizen	Wants to become part of a ‘smart energy community’ and help ensure quality of supply and environment preservation	2.3, 2.7, 2.8, 2.9, 2.11, 2.12, 2.16, 2.17, 2.19

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