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LIVING LAB: USER-DRIVEN INNOVATION FOR SUSTAINABILITY¹

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Abstract

Purpose – This paper summarizes and discusses the results from the LIVING LAB design study, a project within the 7th Framework Programme of the European Union. The aim of this project was to develop the conceptual design of the LIVING LAB Research Infrastructure that will be used to research human interaction with, and stimulate the adoption of, sustainable, smart and healthy innovations around the home.

Design/methodology/approach – A LIVING LAB is a combined lab-/household system, analysing existing product-service-systems as well as technical and socioeconomic influences focused on the social needs of people, aiming at the development of integrated technical and social innovations and simultaneously promoting the conditions of sustainable development (highest resource efficiency, highest user orientation, etc.). This approach allows the development and testing of sustainable domestic technologies, while putting the user on centre stage.

Findings – As this paper discusses the design study, no actual findings can be presented here but the focus is on presenting the research approach.

Originality/value – The two elements (real homes *and* living laboratories) of this approach are what make the LIVING LAB research infrastructure unique. The research conducted in LIVING LAB will be innovative in several respects. First, it will contribute to market innovation by producing breakthroughs in sustainable domestic technologies that will be easy to install, user friendly and that meet environmental performance standards *in real life*. Second, research from LIVING LAB will contribute to innovation in practice by pioneering new forms of in-context, user-centred research, including long-term and cross-cultural research.

Keywords *Living lab, user-driven innovation, sustainable products and services, sustainable innovation*

Paper type – *Conceptual paper*

1. Introduction: Sustainability as a prerequisite for any product or service

Numerous research and policy reports show that the present patterns of production and consumption in the industrialised countries are not sustainable (see e.g. IGES, 2010; Board of the Millennium Ecosystem Assessment, 2005; Giljum *et al.*, 2010; UNEP, 2010; WWF, 2008; WorldWatch Institute, 2009). An ever-increasing energy and resource consumption will disturb the Earth's sensitive biological eco-systems.

The lifestyle of the average population in industrialised economies is characterised by high levels of consumption and is, thus, responsible for an enormous increase of resource extraction and environmental problems. In most countries, household consumption determines 60% or more of all life cycle impacts of final consumption. For industrialised countries recent studies indicate that housing, mobility, food and electrical appliances account for over 70% of the impact of household consumption (see e.g. ETC/SCP, 2009).

Therefore, an absolute decoupling of economic growth from resource use is a precondition for sustainable production and consumption (Barbier, 2009; Jackson, 2008). Our welfare generation has to happen within the natural system boundaries. It must be sure that the ecosystem services provided by nature are not reduced (Schmidt-Bleek, 2009). Currently we are consuming more ecosystem services and more natural resources than nature is providing on a sustainable basis. Thus, a holistic approach is needed taking into account and optimizing the whole production-consumption-system. Only sustainability-oriented

efficiency and sufficiency strategies will be able to solve the future tasks, challenges and problems (Jackson, 2006; Spaargaren, 2004; Schor, 2004; Thøgersen and Ölander, 2002; Welfens et al., 2010). Thus, the future potential for resource efficiency, climate change, poverty reduction and broadening welfare lies in the fields of individual decision-making and behavioural processes combined with organizational learning processes recognizing the social context situation. (Reisch and Ropke, 2005; Thøgersen, 2007; Sanne, 2002; Wenger, 2007) Therefore, we need more information and research results about these processes, we need more knowledge about what people want and how they use products and frameworks in their living environment (Warde, 2005; Shove, 2005, 2003). Such an interactive, sciences and stakeholder integrative research approach needs other test beds, kits and framework conditions.

2. Eco-design as a key precondition for sustainable development

Design is a driver for economic and socio-cultural innovation and communication processes in society; placed between companies and the society, between potentially eco-intelligent need satisfaction and eco-intelligent technical solutions. Design processes are reflecting socio-cultural, economic, and environmental trends and are thus integrated into such trends through a perpetual development process. A modern and innovative design connects the consumer, who is increasingly involved in the design processes (user-oriented design) and the producer. According to a EU report, a modern design and innovation-oriented economy are strengthening the competitive advantage of its companies and economic systems (European Commission, 2009).

Sustainability research has shown that the development and implementation of ecological design is essential for a sustainable society. Design is a determining factor for ecological and social effects of products and their value chain in all life cycle phases. Therefore, a sustainable design is a key for improving resource- and energy efficiency as well as environmental impacts of products and services. Integrating users and all relevant stakeholders in the value chain into development processes can reveal both negative as well as positive human-technology-interactions and therefore reduce problems of acceptance in consumers. Such a systemic approach requires new ecological services together with adequate business- and user models fitting the following definition of eco-innovations, as written in the final report of the EU Sectoral Innovation Watch Panel on Eco-Innovation:

„Eco-innovation means the creation of novel and competitively priced goods, processes,

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systems, services, and procedures that can satisfy human needs and bring quality of life to all people with a life-cycle-wide minimal use of natural resources (material including energy carriers and surface area) per unit output, and a minimal release of toxic substances.” (Reid and Miedzinski, 2008).

Based on this, the LIVING LAB approach is crucial for fostering eco-innovation as its perspective is different from the traditional ‘eco-feedback’ approaches. Instead of reducing the users’ behavioural options to what product developers deem to be the most sustainable – or raising awareness that does not necessarily result in reduced resource consumption – LIVING LAB wants to explore an approach that should lead to long-term effective sustainable innovations in the home by engaging users rather than restricting them or designing around them. This fits the challenge for LIVING LAB to undertake new methods of user-oriented research in order to foster innovation in sustainable lifestyles and products (Jackson, 2005; Shove, 2005).

Modern sustainable homes are often rather high-tech environments. Heating, cooling, ventilation, lighting, communication and energy management systems are all connected and interact with each other and with the home occupants who need to monitor, manage, maintain and live with them (Bakker et al., 2008; Selhofer et al., 2010; Shove, 2003). One of the research challenges is to explore to what extent people can indeed successfully interact with the potentially complex range of in-house systems, and to what extent this interaction contributes to sustainable households over time (Sannford and Harris, 2006; Warde, 2005). This leads to the following research objectives: To understand the relationships between home occupants’ behaviour, domestic resource consumption and domestic systems (products and technologies), with the aim of minimizing the resource consumption and waste production, while optimizing user experience and comfort.

LIVING LAB is an integrated technological socio-economic approach to enable optimised interaction of production and consumption. Technological and social innovations can only be developed interactively by mirroring, explaining, and integrating emerging trends and consumer behaviour. This is and will be essential for companies and consumers because individual or social milieu oriented solutions are going to play a significant role in a continuously differentiating “World Society”. For instance, the social phenomenon *swarms* exemplifies the difficulties and open questions about how to respond to new trends and behaviour (Surowiecki, 2004; Couzin and Krause, 2003). However, the product and service mix equivalent for swarms may be quite different to the one of traditional households. This

kind of questions must be understood when developing products that shall be sustainable and accepted by new groups of consumers.

3. The LIVING LAB approach

Traditional methods for generating insights about consumers rarely make it possible to experience the full benefits of new or hypothetical products, and often fail to predict accurately whether consumers will understand the technologies that underpin truly innovative products. As a result, new products and innovations often fail in the market, and companies have increasingly poor returns on their investments in product innovation.

Thus, user-centred research can have commercial value for companies by helping alleviate the risk involved when launching a new product, technology or service. At the same time, in designing such products more and more attention is given to improving environmental sustainability, while maintaining quality of life. A user-centred approach is needed here too, because all too often products, that were designed for environmental efficiency under given circumstances, are misused or overused, resulting in unintended and generally less sustainable outcomes ('the rebound effect'). There is a need for sustainability-oriented user insight to assess and improve the true impact of sustainable innovations around the home.

A LIVING LAB is a combined lab-/household system, analysing existing product-service-systems as well as technical and socioeconomic influences focused on the social needs of people, aiming at the development of integrated technical and social innovations – new product mixes, services and societal infrastructures – and simultaneously promoting the conditions of sustainable development (highest resource efficiency, highest user orientation, etc.) and respect the limited numbers of natural services we can use without destroying the ecological system. Therefore, this research approach is highly relevant for developing sustainable products and services as it allows the development and testing of sustainable domestic technologies, while putting the user (i.e., home occupant) on centre stage. The two elements (real homes *and* living laboratories) are what make the LIVING LAB research infrastructure unique. The research conducted in LIVING LAB will be innovative in several respects. First, it will contribute to market innovation by producing breakthroughs in sustainable domestic technologies that will be easy to install, user friendly and that meet environmental performance standards *in real life*. Second, research from LIVING LAB will contribute to innovation in practice by pioneering new forms of in-context, user-centred research, including long-term and cross-cultural research.

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LIVING LAB is a research infrastructure that focuses on research of the development of user-integrated product-service systems (PSS). Its overall goals are to

- map resource consumption and user experiences of sustainable innovations in the home.
- understand the discrepancy between people's awareness and actions concerning the use of sustainable innovations in the home.
- model factors in the use phase of sustainable innovations in the home influencing adoption and resource consumption effects.

Furthermore, it aims to develop new longitudinal methods of user-centred design, building on co-creation and open innovation approaches. As most research in this field is of an explorative, qualitative nature, one of the challenges LIVING LAB will be facing is to come up with more robust approaches, addressing issues such as validity and generalization over larger user groups.

In order to integrate knowledge of the use of sustainable innovations in the product and service design, the LIVING LAB approach tries to

- develop methods for contextual, social, user-centred design, early prototyping and testing.
- explore open innovation processes for the development of sustainable solutions.
- offer different standardised research protocols and data collection methods, hence to provide comparable results between the different LIVING LAB facilities as well as reliable and valid information according to scientific criteria.

Additionally, the dissemination of knowledge across the LIVING LAB network and beyond is an important public function of this research infrastructure. To disseminate knowledge on user and design practices facing the sustainable challenges within the EU community the Living Lab approach tries to

- establish and maintain an expert centre on sustainable solutions.
- manage databases (user studies, data analysis and collection etc.) which support knowledge development, transfer and application of sustainable solutions on the national and European level.

This research approach will not focus on one area exclusively, such as home automation or energy conservation. Instead, it takes a broader, more *holistic perspective*. Furthermore, it

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takes a *systemic approach* focused on *user practice*. It therefore can be a strategic research instrument for science, companies and society. It should help to generate competitive advantages matching sustainable requirements and contributions. It should give the possibility of arranging a competition of product-service systems for the highest resource efficiency solution (including benchmarking processes). For public awareness it is necessary to show the results and to position the product-service systems in a global economic system. Users should be actively integrated in research for the best sustainability solution.

4. The LIVING LAB research agenda

Five research lines have been elaborated on the basis of a foresight process that started from a selection of global megatrends. An expert panel of the LIVING LAB project consortium analysed these megatrends and ranked them according to their relevance in terms of sustainability and in terms of LIVING LAB. As trends “relevant for LL” were defined those related to areas and developments that affect innovation intensity, competitiveness and user orientation. The experts were supposed to place the megatrends on a ranking system from ‘0’ (not relevant at all) to ‘5’ (extremely relevant) (see table 1).

Table 1: Megatrends selected as relevant for LIVING LAB

Megatrend in order of importance	Relevant aspects regarding LIVING LAB
Resource scarcity and efficiency	This represents the most relevant trend for the idea of the LIVING LAB project. Again this factor underlies the basic concept of the LIVING LAB project.
Climate change and environmental threats	
Urbanisation	Fundamentally changes lifestyles and consumer behaviour. Increases the need to find solutions for space saving and sustainable living.
New consumption patterns	Creates new consumer groups with new demands. Important to research because of its close link to the question of how to create a sustainable market.
Ubiquitous intelligence	Immediate impact on product development. High market potential for future competitiveness.
Individualisation	Directly leads to an increase in resource consumption. Results in the diversification of lifestyles that increases the demand for tailor made products.
Digital Lifestyles	Potential for new forms of product systems with high resource efficiency. Facilitator for innovation, user central production and knowledge diffusion.
Knowledge-based economy	Consequence of globalization and the relocation of manufacturing

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Knowledge-based economy	Consequence of globalization and the relocation of manufacturing activities. Innovativeness which is the single most important factor for successful product development, becomes ever more important for European competitiveness. Generates opportunity for development of services that can substitute goods to save resources.
Cultural diversity	Creates the need for sensitivity towards multicultural consumers and constant changes of the composition of European populations. Increases the importance to consider differences in norms as a prerequisite for sustainable consumer behaviour.
Demographic change	Notably high impact on household size and composition. Fundamentally changes consumer patterns.
New mobility patterns	Induces one of the highest impacts on the environment by households. While mobility is external to LIVING Lab's central research site, the household domain creates the need for mobility, which means that diversification of household functions can potentially make mobility more sustainable.
Health thrives	Directly shapes product design and development. Goes hand in hand with resource-conscious consumption and production.

(Source: LIVING LAB Grant Agreement no. 212498 Annex I – “Description of Work” [2007])

Relevant research questions and topics were elaborated in a matrix on the basis of a cross-impact analysis of the most relevant megatrends and the basic functions of homes. Based on a thematic analysis and clustering of these research questions, five research lines were formulated in order to structure the potentially broad scope of LIVING LAB research into manageable foci:

- Design, construction and maintenance of sustainable homes
- Integrated approaches to home energy management
- The connected home
- Resource-efficient lifestyles and social networks
- New product and service development

The research lines aim at being innovative and explorative but also traceable in their development. Furthermore, they were conceived to be related as closely as possible to current societal developments that influence questions of sustainability, innovation, competitiveness and the project's focus area: the home.

4.1 Research line: Design, construction and maintenance of sustainable homes

The LIVING LAB facilities could serve as highly visible examples of sustainable homes. They should be designed to perform at the frontier of sustainable building systems: radically reducing emissions, materials consumption, energy and water use. The facilities should be conceived and designed collaboratively with actors in the value chain and users as a 'process' rather than a 'product', allowing for the widest possible range of experimentation on the local scale.

Research involving construction industry, craftspeople and other building experts should be dedicated to construction related topics before, during and after the occupation of a LIVING LAB facility. Research topics may, for instance, include:

- The development and application of easy to install systems, technologies and materials with a high user acceptance, high sustainability performance and market success. This refers to technologies for both new construction as well as refurbishment.
- The development and application of user-friendly systems, technologies and materials that can easily be dismantled, separated and reused or recycled.
- Monitoring and management of communication processes and feedback loops between actors and decision makers in the planning and construction process.

4.2 Research line: Integrated approaches to home energy management

LIVING LAB can provide a unique opportunity to study the integration of demand based energy offerings and related services in combination with smart appliances and low-energy heating and lighting solutions. Complex home control technologies, computers and internet are becoming an integral part of the home environment, thus the influence of information technology on user practices at home is strongly increasing. The focus of this research line is on developing interactive designs and smart systems (smart meters, smart grids) that can encourage and support home dwellers in saving resources.

Much research is conducted on adaptive and intelligent systems that can, on the one hand, improve the dweller's well-being, but also have a strong influence of the sustainability aspects being studied in the first research area. Similarly, the digital user environment can be adapted to accommodate and support users at home. Given the upcoming deployment of *Smart Metering* and *Smart Grids*, whereby two-way communication between householders and utility companies will be possible, new opportunities towards designing interactive systems for energy savings have arisen.

The focus should be on developing interactive designs and smart systems that can encourage and support home dwellers in saving energy. Techniques from persuasive technology could be further developed and applied by considering how the product interacts with the user in terms of:

1. The physical design of the product, including perceived physical affordances, ease of use, and pleasure in use.
2. Social interaction issues, including perceived social norms, for example how much energy is being consumed by an equivalent household in a similar sized house.
3. The perceived environment as recognized by the energy savings system, including issues such as amount of daylight, outdoor temperature, or detected user activities.
4. Financial and environmental incentives, for indicating what time of the day is there a grid surplus of green energy.

Central to testing and developing interactive products and displays for energy savings is the notion of user-centred design, whereby users can be directly involved in the development and testing of the product. Given the complexity of user and environmental factors which may influence energy savings behaviour, working prototypes should be placed in a real-world context, involving actual consumers (see table 1 in appendix “Open Innovation Sessions (OIS):Improving energy awareness and efficiency in households by means of smart metering and smart grids – A user centred perspective” for an example research project in the context of this research line).

4.3 Research line: The connected home

Virtual services (such as tele-working, teleshopping and social connectedness) have the potential to radically change habits, develop new market opportunities and foster resource efficiency at the same time. The main research focus here is to what extent and in which way living in a connected home can promote sustainability, beginning at the level of the single dwelling and extending outwards from the local neighbourhood and beyond.

Even if LIVING LAB focuses on the home environment, events that occur outside the home may not be neglected. This is illustrated by the fact that activities connected to the home heavily interact with activities in other places. Certain activities, which need interaction with

exterior elements, however, can be fulfilled virtually without leaving the home. Some examples of these activities could be:

- Virtual relationships and entertainment. Social networking websites are used to communicate with other people, send messages, share photos and videos, make new relationships... in short, to connect people.
- Virtual learning and advice communities. In these online communities people can share personal stories of specific issues (medical, social, professional...), find similar experiences and offer useful and practical advice to others in similar situations.
- Web shopping. Booking, buying and selling products or services over electronic systems such as Internet allows the user to save a considerable amount of time and make much easier all these processes.

4.4 Research line: Resource-efficient lifestyles and social networks

This research line studies lifestyles and consumption patterns. That is to gain insight in the role of the user regarding efficient resource consumption and waste streams including gas, water, electricity, but also use and disposal of packaging materials. The use of resources is dependent on age, education and socio-economic situation of the user. LIVING LAB could be the place to research not only those parameters and their mutual effects but also the resulting lifestyles of people. Studies (e.g. Kotakorpi *et al.*, 2008) have shown that even within groups that are rather similar regarding the characteristics mentioned above, individual consumption patterns lead to vast differences in the amount of energy and resources used in a household. Those varying consumption patterns may be connected to different recognizable consumption decisions or overall lifestyles.

Furthermore, the impact of training sessions for end consumers to reduce their consumption (energy, water) as well as consumption awareness tools (e.g. smart metering) is a central point to study within this research line. Are users changing their behaviour because of teaching or awareness instruments? Are energy savings achieved? What kind of instruments or methods are adequate (visualisation with colours, graphs or figures)? Is it necessary to fresh up training sessions regularly? (See table 2 in appendix "Multi-market insight generation for less resource intensive bathing practices, different European countries" for an example research project in the context of this research line).

4.5 Research line: New product and service development

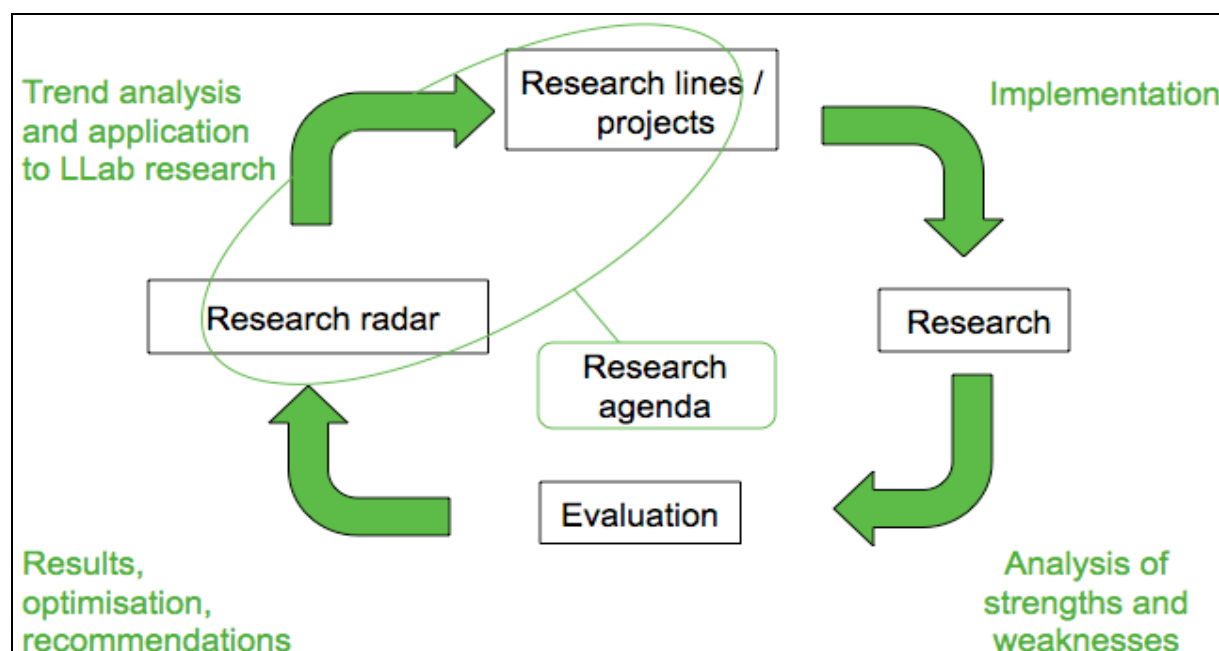
Products with significant environmental effects in the use phase should be developed in LIVING LAB with a clear focus on the user context to prevent unwanted side effects. Looking at the increasing percentage of electronic devices used at home in all domestic areas, furthered by the growing trend of working at home, the possibilities of creating new sustainable practices around such activities seem endless, especially at this early stage. Within this research line, we are aiming for user-centred research around complete product-service systems, e.g. “sustainable washing” could research the usage and behaviour system of clothes, washing machine, laundry detergent, ironing, but also washing services or shared facilities.

Several strategies for user-centred sustainable innovation have been developed and reported on (Bakker *et al.*, 2008). The strategies can be categorized according to their level of intrusion on user behaviour: from those, which design technologies around current user behaviour to those, which design products to promote certain behaviour in users. However, here we seek to understand how we can look beyond the product or technology level and study current behaviour and develop new ways of doing, including products/technologies, that are more resource-efficient while optimizing the user experience.

5. Conclusions

The LIVING LAB research agenda is supposed to be a part of a whole management cycle. Thus the research agenda is not a terminal document but rather opens up an iterative process. As stated in the introduction, the agenda at hand was produced as research radar. Building upon deliverables already elaborated during the LIVING LAB project and using trend analysis, a potential research field was spanned. Out of this research field, as shown in the LIVING LAB research map (see figure 1), several research lines were developed. Clearly, the next step is the implementation of projects - based on the research lines and in a LIVING LAB research infrastructure.

Figure 1: The LIVING LAB research agenda as a continuous technology platform and research radar process



Once the first projects are conducted, evaluation will be necessary in order to analyse strengths and weaknesses that appeared. This evaluation again will be point of departure for a new research agenda, adjusting research infrastructure and projects. Processing new societal, technological developments not yet on the horizon, a continuously updated research agenda is a prerequisite for successful, i.e. relevant research at LIVING LAB.

Depending on the extent and shape of LIVING LAB in the future, the need for a research agenda on the national level or for a single part of the research infrastructure may arise. In this case, nevertheless, an overall agenda is necessary in order to coordinate LIVING LABs on a European level, safeguarding the advantages of a European network, e.g. mutual learning, economies of scale and flexibility in the light of fast changing requirements in user-centred innovation research.

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Appendix

Table 1: Example research project in the context of research line 4.2 “Integrated approaches to home energy management”

<p>Open Innovation Session (OIS): Improving energy awareness and efficiency in households by means of smart metering and smart grids – A user-centred perspective</p> <p>Countries: Switzerland, Germany, Netherlands, Spain</p>
<p>Project goals and background</p> <p>Goal: Improving energy awareness and efficiency in households by means of smart metering and smart grids with focus on the user.</p> <p>Background: Conduction of Open Innovation Sessions with the same set-up in four different countries. Comparison of all four sessions and identification of cross-cultural differences. Using these findings for the development of customized products and services.</p> <p>Problem: Smart meters are not implemented in households to improve energy efficiency.</p>
<p>Research questions</p> <p>Topic 1: User acceptance and adoption of energy-awareness devices</p> <ul style="list-style-type: none"> - How can you overcome these obstacles? (fear of unauthorized access, high costs, ...) - How can you make households (singles, couples, parents, children, ...) understand energy consumption and where / how it can be saved? - How can you promote something new? <p>Topic 2: User involvement in energy saving and consolidation</p> <ul style="list-style-type: none"> - How can you visualise energy consumption? - How can you keep users involved in energy saving on the long run? - How and what kind of energy-feedback solutions can you use to motivate the different people (singles, couples, children, visitors, ...) in a household or even a whole neighbourhood to save energy? <p>Topic 3: The Future - Smart grids, smart metering, sensors, internet...and their possibilities for energy saving</p> <ul style="list-style-type: none"> - How can you communicate (energy-feedback)? - How can you use real-time energy-cost-feedback and price predictions to adjust behaviour? - How and what kind of energy-feedback solutions can you use in public buildings, offices, schools to save energy?
<p>Set-up of the OIS:</p> <ul style="list-style-type: none"> - Questionnaire ‘expectations’ - Basics” presentation smart metering - Several input presentations by guest speakers - Discussion of three central topics - Mind mapping - Creative workshop (generating ideas and solutions in groups)

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- Concept development
- Presentation and discussion of the ideas and concept
- Evaluation of the session (questionnaire)

Wrap-up:

1. Evaluation of each session concerning

- content smart metering
- use for LIVING LAB (method Open Innovation Session)
- Comparison of results from all four sessions.

Included LIVING LAB phase(s)

Prototyping, co-creation and validation of sustainable innovations (in dedicated modular LIVINGLAB test houses).

Added value of LIVING LAB

Users are considered a source of inspiration and innovation in order to co-develop and validate innovative solutions for sustainable households. Simultaneous **cross-cultural research**, evaluating use and acceptance of sustainable innovations in different countries.

Table 2: Example research project in the context of research line 4.4 “Resource-efficient lifestyles and social networks”

Multi-market insight generation for less resource intensive bathing practices, different European countries

Project goals and background

The goals of the project can be divided into two categories, a theoretical goal and a practical goal. The theoretical goal is testing the applicability and effectiveness of a novel approach to Design for Sustainability (DfS). The practical goal is generating insights and early product ideas for the reduction of household resource consumption through design.

Practice theory applied to Design for Sustainability

Household appliances have become more energy efficient through eco-design strategies; however the desired effect of reduced household resource consumption has not been reached. On the contrary, household resource consumption in the Netherlands has increased 24% in the past twenty years (MilieuCentraal). Research into this discrepancy points out two important factors that are currently underexposed in DfS methods. They are (1) integration of a use perspective and (2) a viewpoint beyond single products. Based on these recommendations the proposed DfS method integrates principles from practice theory into a co-design method. Cross cultural analysis was included to gain practice level insights.

According to practice theory, focusing on technical solutions and individual behaviour while assuming peoples’ ‘needs’ as fixed entities, not only disregards the dynamics of everyday life in which technologies create needs and conventions constantly change. It also stands in the way of the more radical change needed to reach sustainability goals. On the other hand, an often heard

criticism on practice theory is its lingering in the theoretical arena and lack of practical applications.

Using the example of bathing, this project aims to create, test and illustrate a practical application of practice theory with the goal of reaching reduced resource consumption in the field of product design.

The focus of the method is on the early phases of product development, generating insights and early product ideas without working towards fully developed products.

The proposed design method currently focuses on the generative phases of the product development process. It consists of two steps. In the first step a group of users is asked to come up with and experiment with less resource intensive ways of doing in the context of their own home. They are asked to describe their current practice and reflect on their experiments. A workbook (cultural probe) with assignments and reflexive questions loosely guides them in this process. The second step is a group session in which the experiments and experiences of the participants are used to generate product ideas to support the less resource intensive ways of doing.

Cross-cultural approach

Furthermore, this study takes the assumption that looking at cultural diversity can widen the variety of insights which can be used as a source of inspiration for designing sustainable practices. However, there is a lack of clear-cut approaches for collecting information on sustainable everyday practices from multiple cultures. The research therefore addresses two needs:

- To increase the variety of insights on possible less resource-intensive practice
- To improve the precision of data on resource consumption

Therefore, this study explores what kinds of insights can be gained through comparing bathing practices between groups in different markets and how this information is taken up in co-design efforts.

Research questions

- Is the proposed practice oriented co-design method applicable for the generation of product ideas? If not, how can it be improved?
- How does cross-cultural information influence product idea generation?
- Do the ideas generated have potential to (radically) reduce household resource consumption? If not, why?

Content, Methodology, Outcomes

The project will start with a preparation phase in which the workbook and other materials are prepared and participants are recruited. Then the participants (between 10 and 15) will work on the workbooks, including the design, execution and reflection of bathing experiments for a period of two weeks. Insights from the cross-cultural analysis will be used as input to inspire participants. At the end of the two weeks the participants will come together in a group session led by a professional facilitator.

Participants will be selected through the European 'LIVING LAB user network'. The workbooks will be prepared using the principles of cultural probes, including insights from other creative techniques developed in co-design (see example in figure). The content and assignments in the probes will be inspired by practice theory (for example asking a parent about their childhood bathing memories). Two weeks before and during the two weeks of experimenting, water consumption of the participants will be measured with equipment from the mobile LIVING LAB 'suitcases'. The group session will use familiar brainstorming techniques, again complemented with principles of practice theory.

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Outcomes can be divided into two groups: (1) information about the applicability and correspondence of practice and theory of the method and (2) ideas and insights related to bathing. Both will be qualitative data gathered through interviews, the workbooks, online blogs and material and video from the session.

Included LIVING LAB phase(s)

Insight generation (phase 1)

Added value of LIVING LAB

The LIVING LAB research infrastructure is relevant for this research project for a number of reasons:

- Mobile research equipment 'suitcases' to measure water consumption of the participants in their own homes
- Europe wide LIVING LAB database of users and companies interested to take part in such studies
- Expertise present in scientists and practitioners connected to LIVING LAB on making cultural probes, leading sessions, qualitative data analysis