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The value of participatory approaches in developing energy services

Abstract

How can stakeholders be involved in the development of energy services to increase energy efficiency? What is the optimal process for engagement? This is what has been tested in this Living Lab, which focuses on energy efficiency.

This innovation paper is based on several applied research projects. Its objective is to disseminate research results. The advantages of the Living Lab method for developing energy services are highlighted.

The main steps of the Living Lab Integrative Process are summarized in a checklist for professionals and includes: (1) Selection of a practice, (2) Identification of barriers, (3) Integration of stakeholders, (4) Development of a pilot, (5) Measurement of results, (6) Communication and dissemination.

In conclusion, this vulgarization article facilitates the transition from the local to the global scale by encouraging the development of Living Lab mode initiatives in the energy sector.

Key words: Living Labs, Energy Services, Social Marketing

1. The context: Energy services and stakeholders

This article proposes approaches for integrating stakeholders in the development of energy services using the Living Lab method.

1.1 What is an energy service?

A 2017 study by Michael James Fell indicates that only 0.5% of the 185 scientific articles analyzed by two major energy journals mention "energy service," and only 10% of these studies define what an energy service is. Clarification has, therefore, been required, and Fell proposes the following definition: "*Energy services are those functions performed with energy that are means of obtaining or facilitating the desired services or end states*." Lighting, for example, is an energy service that can be produced using different primary energy sources and leads to a desired end state: illumination in the home or office. How does this service create value? According to marketing researchers Vargo and Lusch, value creation occurs when the service is consumed by the customer (2004). A watt lost during transport does not create any value. In marketing, we are considering the consumer as a co-creator of value. It is, therefore, always a value perceived by the consumer.

It is sometimes thought that consumers are not rational, for example, when they leave windows open in winter. From their point of view, their actions are rational because otherwise they would not behave in this way. For a specialist, it is often difficult to put oneself in the consumer's shoes and understand these types of practices that are detrimental to energy efficiency (EE) and the environment.

1.2 The intangibility of energy services

This perceived value causes problems for energy service providers. Indeed, the value of services is often not perceived. Users expect to benefit from services such as heating, lighting, and ventilation. They realize the value of such services only when they experience poor quality or an interruption in service. This is what was measured in a previous article in a sustainable neighborhood (Mastelic et al., 2016). When the heating system fails in the middle of winter, the value of the energy service is realized by its absence. How, then, can we raise awareness among users of the value of energy services when everything is working well?
It is a challenge to make energy tangible, to make it visible. Today, we are witnessing a decoupling between primary energy and "the desired end state". During our grandparents' time, people were well aware of the primary energy needed because they had to feed the fire to warm their homes. They had to cut wood, carry it, dry it, and manage the supply to the furnace or

woodstove so as not to let the temperature drop. There was a direct and tangible link between primary energy and the desired end state. And what our grandparents experienced 100 years ago, our African neighbors still experience every day. In Europe today, it is mostly an automatic system that does the work for us, and as a result, most of us have lost this link with primary energy.

1.3 Raising user awareness

Energy planners then consider solutions to make the population aware of energy savings. Appealing to users' common sense, they think they can solve the problem by carrying out educational actions. Unfortunately, for the past two decades, science has indicated that, although necessary, awareness and education are not enough to get users to take the desired actions (McKenzie-Mohr, 2000). It is also difficult to produce lasting effects over time, and this type of intervention must be repeated. Admittedly, mentalities have changed, and today, a larger segment of the population declares that it wishes to act in favor of the environment. Attention must be paid to the potential gap between attitudes, intentions, and actions (Kollmuss and Agyeman, 2002). In a sustainable district that was studied and according to the results of the tree of correlations between the satisfaction of living in the district and the various services provided, energy was not among the priorities; they were looking first for satisfactory social relations, an attractive place to live, and a location (Mastelic et al., 2016).

1.4 Limited perceived control

The power to act personally is often underestimated by stakeholders. Most people think there are other, more competent people who will act to increase EE. The problem is not being addressed, as demonstrated by a study on the development of an energy management system (Mastelic et al., 2017). If no EE targets are set by management, employees will not take the ownership of the challenge and leave it to the management team. If employees (and especially custodians) are not measured annually on their energy performance, then why should they act? In addition, stakeholders often do not have much knowledge about energy; they have low "energy literacy." The notion of kW/h is highly abstract for them, and they don't know how much it can represent. Most of the people interviewed in past studies do not know how much they spend on energy, and even if they do, the percentage is a relatively low one based on their total budget (about the price of a cup of coffee a day for electricity in a household) and, thus, provides little incentive for EE actions. Subsidies can, to some extent, provide an incentive for action.

1.5 Automation of energy services

EE specialists, therefore, imagine increasingly complex technical systems that can solve problems. These include automatic lighting with presence sensors, regulation of temperature control in buildings according to theoretical occupancy data, and the use of windows that prevent opening. They use technical and economic models to implement them and sometimes forget that these systems will interact with users. Indeed, as proposed by Geels, they are socio-technical systems composed of rules, technical artifacts, and human actors (2004). User are sometimes forgotten or relegated to the end of the process to test the final service, thought of in a patriarchal way as: *"We know what is good for you"*. Users often do not oppose active resistance in this phase as they have a low technical knowledge and tend to delegate ownership of the challenge to experts.

The problem is that, if the technical solution and/or the rules put into place (system regulation, laws...) do not meet their requirements, users will find inventive ways to try to circumvent the system (bypass use). When specialists encounter blockages, researchers in social sciences are often asked for interventions that promote "social acceptance," a kind of magic wand that would be used to accept technical solutions which do not work optimally. Unfortunately, it is often too late to change the technical artefacts, and only small adjustments can be proposed. It is, indeed, at the start that action should be taken.

2. Ways to promote stakeholder engagement

How to engage stakeholders in a co-design process to co-develop energy services? The following section give recommendations for professionals.

2.1 Transformative research and quasi-experimentation

When we want to act on energy services, we act on a complex system. In such a system, the relationships between variables are not linear, and the preferred way to test whether or not an intervention has an effect is through experimentation (Kurtz and Snowden, 2003). This is referred to as quasi-experimentation because we do not have a random sample of the population. In addition, we work in the field, *in situ*, and therefore, we cannot control all the variables in the system. The effects of certain variables, such as the influence of weather on energy consumption, must therefore be considered.

We are attempting to move from one energy system to another, so we want to change the reality we observe. This is not considered acceptable in all scientific disciplines. We are in a constructivist epistemological paradigm: the researcher is not neutral; we conduct action research that is called “transformative” because it transforms the observed reality (Schneidewind, 2016). The author tested the Living Lab approach to co-design energy services with stakeholders.

2.2 What is a Living Lab?

The Living Lab (LL) approach is relatively new. It has been in place for about ten years at the European level, but few experiments exist in the field of energy services. Research on the “Living Lab” phenomenon is, therefore, in its infancy. Definitions abound, but it remains difficult to capture the complexity of the phenomenon. Here is one definition:

> *A Living Lab is an innovation intermediary, which orchestrates an ecosystem of actors in a specific region. Its goal is to co-design products and services, on an iterative way, with key stakeholders in a public private people partnership and in a real-life setting. One of the outcomes of this co-design process is the co-creation of social value (benefit). To achieve its objectives, the Living Lab mobilises existing innovation tools and methods or develop new ones.* (Mastelic, 2019)

What differentiates the Living Lab from other participatory methods is the combination of several factors, listed in the definition and detailed below:

1) An ecosystem of stakeholders: This laboratory emulates a partnership between public authorities, companies, citizens, and academics. The Living Lab manager acts as a catalyst to build a common vision, provide methods, coordinate experiments, and measure results.

2) Co-designing solutions: The prefix co- means “with.” We do not develop solutions for users but rather with users.

3) An *in situ* environment: Research does not take place in a laboratory but in the place where energy is consumed or produced; it adapts to different contexts.

4) A societal-improvement objective: A strategy for individual well-being is not developed but rather societal well-being is the aim.

2.3 Living Lab for energy services

A Living Lab was created in 2014 to support the development of field interventions and to help achieve the objectives of the Swiss Federal Council's Strategy 2050. It operates in two main sectors: increasing energy efficiency (particularly in the built environment) and the diffusion of renewable energies. After an initial test in the Chablais region, the Living Lab increased its interventions in a portfolio of projects supported by public and private funds (work on the energy performance gap, the dissemination of renewable energies in a village, the dissemination of photovoltaics in French-speaking Switzerland, the deployment of district heating systems, etc.). Some of these interventions will illustrate the purpose and feedback below.

2.4 The process developed by the Living Lab

The process is based on "Community-Based Social Marketing" as proposed by McKenzie-Mohr (2000) and integrates knowledge of social marketing and social psychology. Marketing gives particular importance to the choice of targets for interventions. You can't talk to "everyone" because it's the most effective way to avoid addressing anyone. Social marketing, then, focuses on barriers to pro-environmental or pro-social action. Understanding barriers is key to understanding why EE interventions fail. Measuring results is also central in marketing because, in order to achieve objectives, it is necessary to know how to determine performance indicators and how to measure them. As part of the research, we combined social marketing and the Living Lab approach; this involves analysing and integrating key stakeholders from the beginning of the value chain. Non-specialist actors work alongside experts to co-design a solution (product/service/action plan). It is also important to go into the field quickly to test the proposed solution under development and then return to development iteratively (agile methods).

1) **Selecting a practice.** An analysis of existing data is conducted to determine which practice(s) we want to act on. In the sustainable district studied, for example, the focus was on heating and mobility. We attempt to take a step back and choose according to the context and data rather than choosing a field of use *a priori*. The PESTEL model (political, economic, social, technological, ecological, legal) can also be used to understand the complexity of the usage context.
2) **Integrating stakeholders.** Stakeholders are listed, and then a matrix is used to classify them, in this case, the power/interest matrix (Eden & Ackermann 1998, in Bryson, 2004). We look at who has the power and who has the interest in changing the service, for example, in the case of heating. If citizens are not the ones with the power to make

an impact, why focus on them? We place our research hypotheses *a priori* in this matrix because we do not know *a priori* who has the power and interest. Efforts will also be made to integrate four types of stakeholders, the Quadruple Helix model (Carayannis & Campbell, 2012): academics, public authorities, companies, and citizens/users of the energy service.

3) **Identifying the Barriers.** Qualitative interviews will then be conducted with each of the key stakeholder groups based on the matrix, in order to better understand their perceptions regarding the level of power and interest, their motivations, and the barriers. In one of the fields studied, even the director of the school thought he did not have the power to change the situation. There was no energy-saving objective. Who does have the power if the director doesn't think he holds it? There is often a lack of ownership of the challenge. In LLs, the first step is to encourage stakeholders to take ownership of the challenge. This is achieved, for example, by asking the director in front of the stakeholder assembly: "What is your goal for energy efficiency?" A public and voluntary commitment is necessary. This allows better ownership of the project and future results (Cialdini, 2001). Once we have completed this stakeholders' analysis, we compare our research hypotheses with what stakeholders have mentioned. We redraft a power/interest matrix in relation to their perspectives and see if there are any differences. We also analyse all the other barriers to action such as, for example, lack of cash flow, low motivation, and technical ignorance.
4) **Co-designing the solution.** We then collaborate with stakeholders to co-design a common vision. We have had cases where companies have seen municipalities as actors who are there only to place obstacles in their way. Conversely, sometimes municipalities see companies as interested only in their profit margins. If we do not offer this space for dialogue between actors to correct certain biases, they cannot co-develop a common vision. Qualitative interviews are always conducted first to gain a clear understanding of individual barriers to change and then to moderate this type of multi-stakeholder process that involves building trust between stakeholders (Dupont et al., 2018). Simply bringing people to the table and providing an environment that fosters trust and the development of a common vocabulary often helps to move the process forward. Many tools exist to co-design energy services and are presented in other works by the same authors.

5) **Piloting an experiment.** Primary importance is given to testing co-designed solutions in a real-world situation with authentic users. Agile methods facilitate regular trips back and forth between the experimental field and theory. Today, we see the emergence of laboratories in which researchers live and test new products and services. Although these experiences are similar to a real-world environment, they do not convey the actual and authentic conditions of use, including users' knowledge. Thus, barriers may be overlooked related to technology adoption, culture, lack of time, and a range of social factors that will not be reflected in the test environment.
6) **Evaluating performance.** A measurement and verification plan is proposed before the pilot. EE standards can be referred to, for example IPMVP[1]. A large volume of data is now available, such as energy consumption from smart meters. To interpret the results, it is often useful to collect sociodemographic data using surveys and to cross-reference them with consumption data to provide analyses by consumers' clusters.

3. Impacts of Living Labs on energy services

The Living Lab approach, tested in several research projects or mandates, is beneficial from many perspectives, as presented below.

3.1 Reducing barriers to change

The approach provides a better understanding of barriers to action from different perspectives. A new and "naive" look at the energy challenge is taken. Indeed, barriers are not always found where we expect to find them. An example is the development of district heating system (DHS) in an article from Previdoli and her colleagues (2015). The contracting authority thought that prospects could raise economic barriers, as the installation of the network has high initial costs. However, after stakeholder analyses, a different and unexpected barrier emerged: resistance to change from the environmental service. For years, the service had required the switch from oil to gas. With the arrival of the DHS, a new argument had to be developed to convince employees in contact with prospective users and then the prospects themselves. Without involving all key stakeholders and focusing only on users, this important barrier to deployment could have been missed.

[1] International Performance Measurement and Verification Protocol

3.2 Development of a common vision

An ecosystem of actors is integrated into the reflection from the very beginning of the projects. The first step is to network the partners and define a common vision. Interactions and mediation promote trust-building and knowledge-sharing (collective intelligence). The LL method makes it possible to build bridges between actors and between disciplines.

An example is the municipality of Saint-Martin. The president of the village tested the LL method to develop renewable energies in the village. School children, aged 12 years old, teamed up with engineering and economics students from a university to propose a renewable energy development plan for the municipality. The best project was selected by experts and presented by the young people to the primary assembly. The latter accepted the budget for the preliminary studies for the deployment of the plan in the village by local companies.

3.3 Increased perceived control by change agents

Stakeholders sometimes feel that they cannot act. The example of the hummingbird, cited by Pierre Rabhi, comes to mind. The little bird is the only animal who attempts to extinguish a raging forest fire by filling his beak with water and spraying it. The other animals tell him not to bother as he won't make a difference, and the tiny bird answers, "Maybe so, but I'm going to try." In the energy field, stakeholders also need examples, support, and reassurance to give them confidence that they can act and have an impact. A project in LL mode tested the TupperWatt evenings, workshops that bring neighbours together around the theme of EE. An expert attends and presents technical solutions. The participants can freely express the obstacles they foresee, and the exchange of experiences is rich in learning. EE materials are then offered for sale, and participants are given a "good practice" guide and a small gift. In this way, they become aware that they can act at their own level.

3.4 Changing the role of users

Users become active co-designers of the energy services and even sometimes prosumers. Users have often lost their link with primary energy; they have become passive consumers of automated services. As part of the LL's activities, we are trying to give them back an active role as co-designers alongside specialists. For example, we have developed a serious game: the poker design (initially proposed by Cité du Design from St-Etienne). After conducting qualitative interviews with stakeholders, personas, a kind of stereotype of the system's actors, were created. For example, there is the energy distributor, the elderly person in subsidized housing, the employee of the real estate agency, etc. We then developed three types of cards:

(1) persona, (2) actions, (3) uses. Stakeholders were able to combine the cards to develop an EE plan for their neighbourhood. For example, the “energy distributor” card is chosen, which “encourages” the “inhabitants” to “install a HYDRAO shower head to save water.” The persona allows users to take a step back from their own practices and to avoid guilt. The game stimulates discussions and the co-design of solutions to be implemented in the neighbourhood.

3.5 Increasing the social acceptance of systems

When stakeholders come up with ideas to improve energy services, they express their own needs. Co-designed solutions are closer to these needs. They are all the more easily adopted by the actors, even if they did not participate in the co-design process. In the example of Saint-Martin cited above, the whole village is behind the projects of mini hydraulic turbines in drinking water systems, joint tendering for solar panels on public and private roofs, and DHS in the village. The assembly unanimously voted the budgets to implement the plan developed by the children and students, and local companies are working on it.

3.6 Reconnection to primary energy

When working with participatory methods, actors re-examine questions that they had omitted, such as the source of primary energy (“Where does the energy I put in my car or in my heating system come from, and who benefits from the money I spend to purchase it?”). Several illustrations of this phenomenon can be cited. During the qualitative interviews conducted to understand the motivations and barriers of the actors to the deployment of a DHS, many understood the need to valorize the energy from waste rather than importing fuel oil (article by the same author). The mental images communicated are often more meaningful than the words: “Imagine the distance that fuel oil must travel in tankers and then by road to get here.” The argument of local energy speaks to many and favors the circular economy: the forester who feeds the DHS with wood waste from the local forest reinvests his salary locally.

3.7 Piloting the co-designed service

The quasi-experiments used in the LL method allow the solutions to be tested *in situ* to see the results of the system. This allows quick round-trips between the field and R&D to adapt the energy service. For example, one idea that emerged several times in the co-design workshops was to develop a large red button for households to turn off all sources of unnecessary electricity consumption when leaving the house. This is a simple idea based on a common need and could be installed by default in senior citizens’ housing, for example. Its implementation is more complex, however: Do we really want to cut everything off? This requires prior testing in a real-world setting, which is the case in the studied sustainable neighbourhood.

4. Conclusions

How can we achieve the energy transition while engaging key stakeholders? The share of household energy consumption is very high, accounting for about half of the total consumption. It is, therefore, illusory to imagine an energy transition without citizen. It is also completely unrealistic to imagine that, by giving them information only, this could be enough to get household users to drastically change their consumption practices. Although they represent about half of the energy consumption, these consumptions are highly diffuse, with very varied uses. It is, therefore, difficult to establish a cost-effective economic process to help them reduce their consumption because, apart from communication solutions, which have demonstrated their limits, the time required to help them achieve an energy transition within the expected time frame generates significant consulting and support costs. This transition will have to be rapid and will be very difficult to achieve without effective participatory approaches. LL's approaches are perfectly aligned with this spirit, as co-designed solutions are more easily accepted. Many indicators demonstrate the awareness of the population—and young people, in particular—of the need to reduce our impacts on the environment. This is very encouraging and adds one more reason to help redefine market rules. We must accelerate the energy transition, for example, in the field of construction where, with a rate of 1% per year of renovation of existing buildings, it would take us 100 years to refurbish our real estate assets. We obviously don't have that time available. Today, a large part of the activities conducted by economic actors i will have to be refocused on actions around the energy transition. This is also true for universities and the institutions that finance them. They should contribute with a managerial impact to the reduction of CO^2 emissions and the production of renewable energies, not only through theoretical contributions. There are currently many solutions on the market that are energy efficient, both technically and financially. The deployment of these solutions should be supported with as many resources as fundamental research on technological solutions. Clearly, technology must continue to evolve, but in today's society we need much more action around stakeholders' participation, who will ultimately decide whether or not to join the collective effort. This is certainly the main benefit of "action research" to promote the energy transition that really contributes, here and now, to increasing the production of renewable energies and reducing CO^2 emissions.

5. Checklist for getting started with the "Living Lab Integrative Process"

The Living Lab Integrative Process is explained step by step in the following checklist. The aim is to transmit the standardised method to professionals and researchers wanting to experiment it.

Figure 1. Living Lab Integrative Process

1. Selecting a practice

Study the available data on your energy service. What are the practices of the actors that have a strong impact (positive or negative) on the efficiency of your energy service? Select between 1 and 3 practices (e.g., taking a bath instead of a shower, leaving windows open, changing the temperature set point, allocating charges to the residential surface...). Try defining the "roots" of the problem and not only the symptoms.

2. Integrating stakeholders

Make a list of stakeholders who have influence over your energy service. Try to place them on the power/interest matrix (your own assumptions): (e.g., the commune's energy delegate, the building janitor, the end users, the financiers of the solution, the energy distributor...). (Eden & Ackermann 1998, in Bryson, 2004).

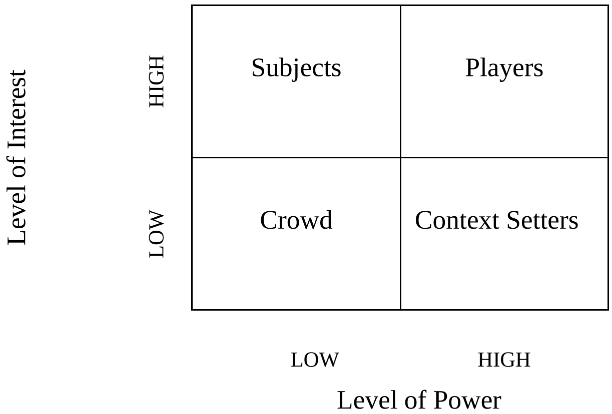

Figure 2. Power-Interest Matrix, adapted from Eden & Ackermann in Bryson 2004.

3. **Identifying the barriers**

   Interview the key players individually (box: Keep satisfied, Manage closely, and Keep informed). Are your assumptions true? What are the barriers and levers of action of these actors toward efficiency?

4. **Co-designing the solution**

   Then bring together the key players (e.g.: workshops, world cafés, BarCamps). Ensure that you invite the four types of actors: companies, public authorities, citizens/users, academics. Work toward developing a common vision and shared objectives for your energy service. Co-develop the solution WITH users, not FOR users (using design service, design thinking, crowdsourcing, etc.). Adapt your vocabulary to an audience with a low level of energy knowledge.

5. **Piloting an experiment**

   Test the co-designed solution in the field and not in the offices! Collect feedback to improve your energy service (interviews, ethnographies). Perform as many iterations as necessary without waiting for a final prototype (agile methods).

6. **Evaluating performance**

   Establish the measurement and verification plan before the pilot (e.g., IPMVP) and evaluate the results regularly. Triangulate the data to verify your conclusions (qualitative/quantitative, simulation/real consumption data etc.).

7. **Communicating results and replication**

   Communicate the results of your project to all stakeholders and celebrate success with them (media communication, end-of-project event, etc.). Share your success to allow others to replicate it (open innovation, open science).

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