Roles of Stakeholders in Energy Living Lab

Subjects: Urban Studies | Regional & Urban Planning | Public Administration

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The living lab concept in energy transition research is still relatively new, but it has piqued the interest of policymakers, researchers, and practitioners. While Følstad claims that the living lab concept originated in the 2000′s with private firms conducting real-life testing and experimentation for information and communication technologies, Leminen et al. contend that the concept first appeared in 1749. The living lab concept is identified as having the potential to provide a platform to test technologies and support energy transition.

energy living lab | energy transition | sustainability | gender mainstreaming

1. Stakeholders and Their Roles in a Living Lab Outside the Energy Context

The literature has significantly acknowledged the importance of involving end users and multiple stakeholders in a living lab. End users in living lab studies are perceived as co-designers who actively participate in developing products and services [1][2]. A stakeholder is described as an individual or group that is affected or potentially affected by a particular decision or development [3]. With this perspective, Dvarioniene et al. [4] p. 514, define stakeholder participation as “a process of involving everybody who takes an interest (or “stake”) in a project to foster its acceptance, get contribution and support as well as manage possible conflicts and oppositions”.

The stakeholders involved in living labs outside the energy sector were mentioned in 11 of the sampled studies (see **Table 1**). These studies fall within the sectors of health, education, urban farming, computer and social sciences, and ICT. The stakeholders identified include: (i) private companies and third sector organisations; (ii) researchers; (iii) financiers; (iv) project managers; (v) pilot and panel managers; (vi) business managers; (vii) users; (viii) industry representatives; and (ix) public sector authorities.

Table 1. Stakeholders and their roles in a living lab outside the energy sector.

Stakeholder	Role	Reference
Industry representatives (technology providers, designers, manufacturers and entrepreneurs)	- Offer technical support - Involved in designing, developing, and implementing technology	Buhr et al. [5]; Pertry et al. [6]; Jakobi et al. [7]; Jackson et al. [8]; Suopajärvi et al. [2]; Ahmadi et al. [9]; Ahmadi et al. [10].

Stakeholder	Role	Reference
Researchers, trainees and students (universities/companies)	- Provide methodological support for the living lab processes - Involved in prestudies, need finding, developing concepts, and testing innovation before implementation	Buhr et al. [5]; Pertry et al. [6]; Ahmadi et al. [9]; Jackson et al. [8]; Suopajärvi et al. [2]; Pedell et al. [11]; Chin and Callaghan [1]; Ståhlbröst et al. [3].
Users (residents, students, households, staff members, the elderly, and citizens)	- Contribute to contextual understanding of living lab by expressing their values, goals and needs regarding a particular situation - Participate in the design of technology - Test technology in real-life scenarios and provide feedback for evaluation	Buhr et al. [5]; Suopajärvi et al. [2]; Pedell et al. [11]; Chin and Callaghan [1]; Ståhlbröst et al. [3]; Jakobi et al. [12]; Masseck [13].
Financiers	- Fund the development and research of the living lab - Evaluate the progress of the project	Suopajärvi et al. [2]; Ståhlbröst et al. [3].
Public sector authorities (city councils and building managers)	- Provide real-world context by contributing their knowledge and experiences of a problem in a particular area - Also considered as problem owners	Buhr et al. [5].
Private sector companies and third sector organisations	- Provide a communication platform between users and project	Ahmadi et al. [9]; Buhr et al. [5].

Stakeholder	Role	Reference
	initiators - Involved in project planning, design, and implementation	
Pilot manager and panel manager	- Interact with users and the wider community involved in a living lab - Provide coordination of real-world experiments and stakeholder engagements - Recruit users and disseminate information about the living lab	Ståhlbröst et al. [3].
Project manager	- Identifies and decides which actors can take part in the living lab project - Oversees research and technological innovations - Disseminates research results	Ståhlbröst et al. [3].
Business manager	- Develops business models and is responsible for the commercialisation of products or services	Ståhlbröst et al. [3].

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phases. However, they are not actively engaged in living lab processes on the ground. Evidence highlighting industry representatives comprises designers, manufacturers, technology providers [8], and entrepreneurs [5]. These actors are involved in designing, developing, and implementing technical solutions and providing general technical support or management in a living lab.

In an urban living lab initiated by the municipality, the private sector and third sector organisations adopted the role of being an intermediary that provides a communication platform between municipal authorities and civil society to express their goals and needs as well as being a coordinator that gathers all human and financial resources required to achieve the objectives of a living lab initiative [5]. Reviewing a ‘smart city living lab process’, Ståhlbröst et al. [3] further highlight the involvement of a pilot manager who is involved in setting up pilot projects within the

living lab, a panel manager who primarily recruits and interacts with users, and a business manager who is responsible for the commercialisation of technology.

Regarding researchers as stakeholders, these actors are shown to be either from private research institutes or public universities and are sometimes identified as participatory design or action researchers, students, and trainees [3][5][9]. Researchers are involved in prestudies to discover the needs and stories of potential users, collect data during the testing phases, develop concepts, and support other methodological processes in the living lab [2][11].

Public sector authorities were identified as city councils and building managers. They contribute knowledge that provides the context of a problem in a particular area, similar to what users do during the need-finding phase. Users (mostly referred to as ‘end users’ or ‘participants’) differ according to the context of the living lab. For instance, in private home settings, they are noted as residents [5] or households [12], while in a medical context, they are described as ‘elderly people’ [11]. Ståhlbröst et al. [3] add that end users, municipal authorities, and building managers are stakeholders who have a moral claim on the living lab and are the owners of problems embedded in that place.

In theory, users are depicted as actual cocreators; however, this has been proven to be limited in practice. Leminen et al. [7] state that within a living lab, a user may adopt the role of being an informant, a contributor, a tester and/or a cocreator. A cocreator is described as an inexperienced technological designer who, without being made aware of the possibilities, may not accurately articulate what they want during the design processes. Hence, they work with other (‘expert’) stakeholders to design, develop, and produce tangible solutions in a mutual learning environment [11].

In practice, the role of the user was therefore primarily described as an informant during the conceptual phase, an experimenter or tester of existing technology during the implementation phase, and a contributor/collaborator influencing designs in the evaluation of existing technology or systems [2][3][11][12]. In a city-wide living lab environment, poor user involvement is attributed to the inability to define who the user is and the lack of financial resources [2].

2. Stakeholders and Their Roles in a Living Lab within the Energy Sector

The stakeholders involved in living labs in the energy sector are mentioned in 14 of the sampled papers and include the following: (i) financiers; (ii) public entities; (iii) researchers; (iv) SMEs; (v) large private businesses; (vi) trainees, teachers, and students; (vii) administrative personnel; (viii) users; and (ix) industry experts (**Table 2**).

Table 2. Stakeholders and their roles in a living lab within the energy sector.

Stakeholder	Role	Reference
Users (building occupants, building managers, homeowners, residents, and staff members)	- Take part in need-finding surveys and other consumer research studies - Participate in brainstorming sessions to generate ideas for energy solutions - Test energy technologies in homes and provide feedback to increase usability	Jahn et al. [14]; Jakobi and Schwartz [15]; Nina et al. [16]; Sovacool et al. [17]; Ståhlbröst [18]; Morgan et al. [19]; Andersson and Rahe [20]; Eon et al. [21]; Eon et al. [13].
Public entities (municipal authorities and energy companies owned by local authorities)	- Provide a legal framework and public support for the living lab - Improve competence in qualification requirements for grants - Take part in brainstorming sessions for generating energy solutions - Support pilot projects initiated by local SMEs in the living lab - Municipal energy departments are a bridge between local authorities, SMEs, and universities, providing a platform that incentivises living lab methods	Claude et al. [22]; Krogstie et al. [23]; Nina et al. [16]; Giannouli et al. [24]; Egusquiza et al. [25].
Industry experts (architects, craftspeople, hardware developers, and engineering consultancies)	- Provide innovative solutions, skills and technical support for the living lab - Take part in brainstorming sessions to generate ideas for energy solutions - Involved in testing, implementation, evaluation, and management of systems and products - Support research projects in the living lab	Andersson and Rahe [20]; Ståhlbröst [18]; Claude et al. [22]; Krogstie et al. [23]; Egusquiza et al. [25]; Woods and Berker [26].

Stakeholder	Role	Reference
Researchers (universities and research bodies)	- Contribute scientific knowledge to support living lab processes - Provide evidence-based considerations in the decision-making process and adjust the customisation of testing strategies according to regulatory requirements, objectives, and resources of the living lab - Involved in data collection processes - Facilitate energy-efficient systemic innovations	Nina et al. [16]; Sovacool et al. [17]; Ståhlbröst [18]; Egusquiza et al. [25]; Woods and Berker [26].
Trainees, teachers and students	- Involved in data collection processes and administering of questionnaires - Involved in vocational training during living lab activities	Claude et al. [22].
Administrative personnel	- Deliver general communication about the living lab and specific stakeholder engagements	Woods and Berker [26].
Private businesses and SMEs	- Own energy technologies that are tested - May request funding from the project to develop technology as solutions to be tested in the living lab	Krogstie et al. [23]; Nina et al. [16]; Ståhlbröst [18].
Financiers	- Fund the living lab project to enable operations	Andersson and Rahe [20]; Ståhlbröst [18].

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living lab and incentivise SMEs to implement pilot projects. The financier plays a role in enabling operations within the living lab by contributing financial resources [18][20]. In Ståhlbröst [18], the SME actor is represented as the owner of energy technology that is tested in the living lab within private homes and can thus be seen as playing the role of a living lab developer or initiator. In contrast, private businesses, also referred to as energy market actors in Krogstie et al. [23], are seen as technology designers who are also at liberty to request funding from project initiators to develop energy products.

Another stakeholder group identified in energy living labs in six papers is industry experts, which include architects, craftspeople [25], hardware developers [18], and suppliers of technology [23]. This group provides industry input about techniques and relevant skills, tests products and systems in the living lab, assists in research analysis, and participates in brainstorming sessions with users and other stakeholders to come up with solutions to energy problems.

Researchers from research institutions contribute scientific and evidence-based knowledge to support decision-making and help realign testing strategies according to the living lab's regulatory requirements, objectives, and resources [25]. Furthermore, in writing about the first energy living lab in the United Kingdom, Sovacool et al. [17] illustrate how researchers are the actors who primarily interact with end users in the living lab, from interviews before the installation of energy systems to surveys relating to users' satisfaction with the system after installation and use. Actors such as trainees, teachers and students assist in data collection processes and partake in vocational training [22]. The administrator is responsible for sending out emails concerning living lab activities and engagements to other stakeholders [26].

The end users in energy living labs, commonly referred to as 'participants', are actors such as homeowners, residents, building occupants, and managers [14][17]. Their roles are elaborated in 9 of the 14 energy living lab papers, which allude to the end users' involvement in various research studies and surveys as consumers of technology as well as their participation in the implementation and testing of installed software and energy devices such as smart metres to assess their effectiveness [15][16]. Similar to user roles observed in living labs outside the energy context described in Section 4.1, end users in operational energy living labs can be seen to serve as informants, contributors/collaborators and testers for evaluating existing energy innovations to increase usability rather than as actual cocreators of tangible solutions.

3. How Are Stakeholders Identified to Participate in a Living Lab?

There is limited evidence highlighting how stakeholders are identified in a living lab project. Only 2 out of 35 sampled studies [4][24] provided information on how stakeholders were identified. Stakeholders can be identified through the mind-mapping method or reverse mind mapping, done individually or during a group brainstorming session. In the two studies by Dvarioniene et al. [4] and Giannouli et al. [24], the mapping of stakeholders was used to generate a list of actors involved in a specific sector (i.e., energy), persons who are considerably affected by a decision or project, or diverse interest groups based on their skills, economic, and political interests or knowledge [4][24]. A visual matrix that clusters stakeholders according to their importance, influence, and power during planning or later implementation may also be drawn from the stakeholder list. In an energy lab context for enabling energy-conscious communities, Dvarioniene et al. [4] further allude to an in-depth stakeholder analysis that claims to be the best method for obtaining a well-represented final list of stakeholders. The authors assert that this simplifies how and when the stakeholders can be involved and helps determine their position or role in the project. The main issues to be considered in the deeper analysis of stakeholders are summarised in **Table 3**.

Table 3. Summary of stakeholder analysis.

Stakeholder Group	What Are the Advantages That the Stakeholders May Have when They Contribute to or Are Involved in the Project?	What Are the Disadvantages That the Stakeholders May Have when They Contribute to or Are Involved in the Project?	Evaluations of the Stakeholders' Contribution or Position
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Source: Adapted from Dvarioniene et al. [3], p. 515.

4. What Are the Stakeholder Recruitment and Engagement Processes?

Literature explaining the recruitment process of stakeholders and end users involved in a living lab is limited. Nonetheless, cold-call techniques that involve sending out email newsletters that call for participation, individually contacting potential stakeholders via telephone, and attending subject-related events to engage with relevant persons are highlighted in one study [10].

End-user recruitment in research to enhance the design interface of smart home technology began by first publicising the living lab study via local radio stations and newspapers [12]. Participants were thus selected when they fulfilled the criteria set by the researchers, which were done through an online portal and later through telephone interviews. Households had to fall within a particular postcode, had to have a stable internet connection, had to provide adequate reasons for wishing to participate, and had to express their project expectations and their knowledge of products and hard-/software prototypes [12].

Stakeholder recruitment processes in most papers concerning living labs in the energy sector are vague. The papers state that end users were either recruited voluntarily [18] or invited to test and evaluate technology [16], subject to their interest in energy solutions [22][23]. In Jahn et al. [14], end users as building occupants seemed not formally recruited but rather participated in the living lab study because operational changes were occurring within their living space. Only Sovacool et al. [17] elaborate on the process of recruitment of end users, which was through the use of telephone interviews. Further, the user recruitment in Sovacool et al. [17] energy living lab was based on a screening process that included households with specific technological infrastructure, permanent residents, and people possessing knowledge about smart energy technologies.

Evidence indicating the operations of engagement amongst various stakeholders and end users involved in a living lab is elaborated in 12 of the 35 studies. Researchers, technology developers, and end users mostly engage directly with each other through a series of face-to-face interviews [21], telephone interviews [17][18], user-pool brainstorming workshops [23], kick-off events [12], questionnaires [26], roundtable discussions [5], and technical workshops [15]. The latter engagements are utilised as instruments for data collection for researchers and developers to enhance their contextual understanding of users and their needs during the early phases of the living lab, inform users about the research programme, and train users on how to install smart plugs.

The literature shows that after the setup and installation phase and during the final technology or system development phase, end users can exchange their immediate experiences with the user community, convey problems, and receive solutions from researchers via online discussion forums, instant messenger groups, and regular phone calls [12][18]. This encourages ongoing dialogue and cultivates close relationships between users and researchers. Overall, engagements between all participating stakeholders in a living lab ensue through regular meetings [9], occasional technical and codesign workshops, conferences [4][19], and focus groups [5][20]. This is where certain stakeholders present the plans and progress of the living lab, and the codesign of technological and scientific solutions amongst expert stakeholders and municipal officials occurs [25][26].

Keeping stakeholders and end users engaged throughout the living lab process is one of the obstacles to collaboration. Some partners either become passive in their participation due to undefined roles and expectations, or the level of commitment decreases, resulting in their absence from certain activities [9][20]. In the case of end users, valuable quantitative data were lost due to household renovations, specific inhabitants travelling or selling their homes while the research was in progress, and users not providing feedback [2][21].

In the literature, there is a gap regarding gendered considerations in living labs in the energy context. The power relations of gender in innovation and design decision-making processes in the IT and ICT industries were, however, highlighted by three studies [2][9][11].

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