LOCAL ENERGY COMMUNITIES: AN INSIGHT FROM EUROPEAN SMART GRID PROJECTS

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ABSTRACT

The paper uses an extended database of real life smart grid projects in Europe, to identify projects related with the new concept of local energy communities and provides some interesting and useful insights. Thereafter, it focuses on different new actors involved in these projects, investigating their roles and responsibilities, as well as the collaboration links among them and with the traditional smart grid stakeholders. Furthermore, the paper explores the enabling role that Distribution System Operators may play in the development and operation of local energy communities.

INTRODUCTION

The collective dimension of energy use is increasingly recognized at European level [1-3]. The New Deal for Energy Consumers acknowledges the role of local energy initiatives as facilitators for consumer participation in the energy market and in the effective governance of the Energy Union [1]. Regional and local energy initiatives can provide a valuable link between decision-makers, citizens and innovators, opening new opportunities for local communities to play an active role in the energy transition [2].

The recent Clean Energy for All European package [3] further provides a definition of local energy community (LEC); however, the current situation exhibits a disperse development, where local energy communities are being formed case-by-case, presenting different technical and organizational characteristics. For an optimal use of both resources and know-how at European level, the challenge is to identify such developments and the related stakeholders in an early stage, to be able to plan accordingly for the future.

Today, more than 90% of variable renewable electricity sources are connected to distribution grids [3], which has contributed to significant upgrade of the distribution networks to accommodate such capacity and as a result, have led to notable increase in the network tariffs for household consumers. In this context, local energy communities can be an efficient way of managing energy at community level and therefore minimizing network reinforcements, by effectively engaging customers in the management of their energy profiles, but also allowing DSOs to manage the operation of their networks using local flexibility resources provided by the local energy community.

In this context, the aim of the present paper is to analyse those projects in the JRC smart grids database [4] that present a community-oriented approach and to identify the involved actors. The paper specifically investigate the roles and responsibility of non-traditional actors as well as the role of more traditional smart grid actors, such as Distribution System Operators, in supporting local energy initiatives. The focus is on three categories of organizations that, for their specific characteristics, are best suited to engage with local energy communities:

- Emerging stakeholders
- Municipalities
- Distributions System Operators (DSOs)

The paper is structured as follows: the next section analyses the smart grid projects included in the JRC database that present a community-oriented approach. Then, the roles and responsibilities of emerging stakeholders and municipalities of the identified projects are presented. Furthermore, the involvement of DSOs and their roles are explored and in the final section some general conclusions are drawn.

LOCAL ENERGY COMMUNITIES IN THE SMART GRID OUTLOOK

JRC Smart grid projects outlook

Since 2011, the JRC has been publishing an inventory of EU smart grid projects, assessing current trends and developments in the evolving European smart grid scene. The JRC inventory offers a valuable tool to explore the evolution of smart grid projects in terms of actor's involvement, employed technologies and projects focus. Previous JRC focused analysis [2] of demand side management projects (DSM) included in the JRC database have shown that DSM projects in the EU are increasingly being designed and developed with a more inclusive approach, in terms of project's scope, engagement strategies and actors involvement. The increasing diversification of organizations involved, in particular local organizations, underlines the emerging interests of project developers in building on existing local partnership to reach and engage consumers.
The analysis presented in this paper is based on the 2017 JRC smart grid outlook [4] and aims at providing

further insights into the shift towards a more inclusive approach to energy consumption, by further investigating roles and responsibilities of actors involved in projects that present a community-oriented approach.
Out of the 952 projects included in the 2017 JRC smart grid outlook [4], we identified 72 projects related with local energy community. These projects represent the base for our analysis.

Actors in focus among the LEC related projects

The JRC report [4] has highlighted that a new group of organizations, defined as "emerging stakeholders" (e.g. energy service providers, municipal utilities, housing associations, transport solution providers, energy cooperatives, etc.) have recently started to collaborate with traditional smart grid actors to implement smart solutions at local level. In general, by "emerging stakeholders" we refer to both, new entities (e.g. energy service providers, aggregators, etc.) and existing actors that are only lately stepping up onto the smart grid scene (housing associations, real estate developers, municipal utilities, etc.). In 28 of the 72 identified projects at least one participating organization belongs to the category of "emerging stakeholder", and in total 76 organizations of this type are involved in the smart grid projects of our database (Figure 1 and 2).

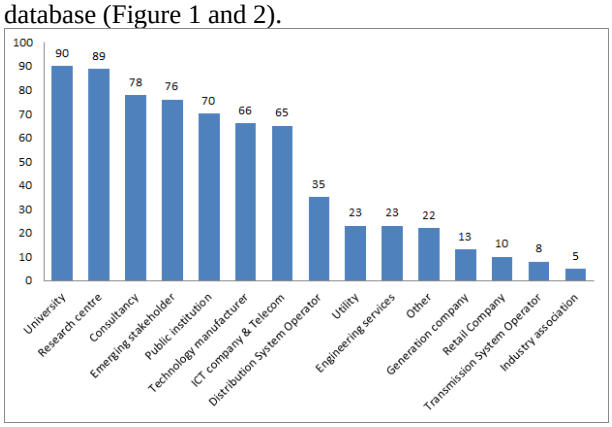

Figure 1. Number of different organization types involved in LEC related projects

Another interesting group of organizations are the municipalities, companies that are wholly or partly owned by municipalities and other local authorities (city councils, development agencies, etc.) which have already established networks and are trusted in their local communities. Out of the 72 LEC projects, 31 include at least one participating organization of this type (Figure 2). In total, 61 of these organizations are involved and in Figure 1 are included under the generic category "Public Institution". In relation to the broader field of smart grids research and for the purposes of this paper, these organizations are considered together with the "emerging stakeholders" as non-traditional actors.
The last type of organization under investigation is the DSOs, due to their enabling role for the operation of a LEC. Based on its general characteristics and scope, a LEC will be mainly located in the distribution part of the power gird, thus will have to collaborate one way or another with the DSO. 30 out of 72 projects include at least one DSO, see Figure 2. In total, 35 different DSOs are involved in these projects.
In general, 55 out of the 72 projects include at least one of the above stakeholders. Figure 2 illustrates the three groups of projects, based on the participating organization.

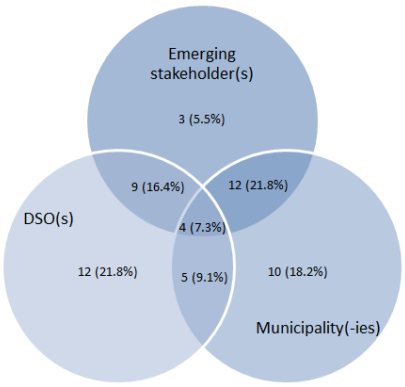

Figure 2. Venn diagram of projects that involve at least one of the stakeholders in focus.

It is easily understood that most of the collaboration is between emerging stakeholders and municipalities. However, also DSOs start to recognise the need to partner with local trusted intermediaries, such as municipalities and other local authorities in developing adequate communication and engagement strategies.
In the next sections, the role of the abovementioned non-traditional actors and of the DSOs, as well as their collaboration links, will be investigated, by focusing on some particularly interesting projects.

THE ROLE OF NON-TRADITIONAL STAKEHOLDERS

The non-traditional stakeholders mentioned in the previous section are involved in the LEC projects with various roles. Figure 3 illustrates how many of them are involved in these projects, where all categories except "Municipalities" belong to the emerging stakeholders. In this section we will analyse the roles of the main types of these actors.

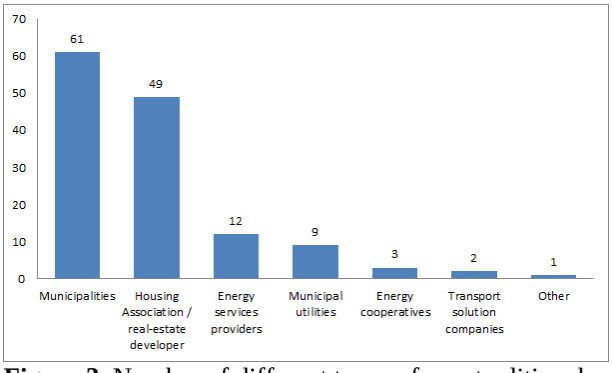

Figure 3. Number of different types of non-traditional stakeholders involved in LEC related projects

First of all, we focus on the 76 partners belonging to the category of emerging stakeholders (Figure 1). Out of them, 49 are a housing association and/or a real-estate developer, 12 are energy services providers, 9 are municipal utilities, 3 are energy cooperatives, and 2 are transport solutions companies. In 4 projects, the emerging stakeholder is the project leader: one energy cooperative, one housing association, and two real-estate developers.

From the emerging stakeholders the most numerous type is the *housing associations / real-estate developers*, which are merged together in one category since in most of the cases they are one single entity. One of the main goals of the projects involving these actors is the improvement of energy efficiency in social/public housing, a field with increasing business interest for such actors. As an example, in the **3E-houses** project a real estate developer from Spain, a housing association from Bulgaria, a municipality from UK and an energy services provider from Germany, collaborate with other actors with the aim to increase the efficiency of state-subsidised residences through the installation of ICT in homes. The project pilot installations promote energy savings in 246 flats and houses, by helping tenants to find out how and when they consume, and learn about how they can manage their consumption. The project **BECA** has a similar goal, i.e. the reduction of energy consumption in European social housing, by providing ICT-based services on resource use awareness and resource management. Nevertheless, its scope is much larger, including five housing associations and two municipalities, along with other stakeholders. The pilots are installed in seven countries (Sweden, Spain, Germany, Italy, Czech Republic, Bulgaria, Serbia) in a variety of buildings used for social housing, which included in total 2278 dwellings, as well as common spaces. Similar projects include **E3SoHo** with 3 pilot sites, **EnergyTIC** and **eSESH**, where along with housing associations, real-estate developers and municipalities, the local DSOs are also involved, and **ICE-WISH**, where a housing association has also the coordinator role of the whole project.

The second most numerous type of emerging stakeholders is the *energy services providers*. Following the LEC approach, as discussed in the previous section, the role of an energy services provider is to facilitate the customers' participation towards the objectives of an LEC, which might include energy consumption reduction, participation in the energy market, optimization of energy production, etc. For example, the project **IssyGrid** has the aim to launch the first urban neighbourhood smart grid in France for testing new power network technologies and services. IssyGrid follows a unique approach in France because it does not include any public organization, but it is driven by a group of businesses located in the community and expanded to other companies. An energy services provider collaborates with generation companies, ICT and telecom providers, retail companies, technology manufacturers and the local DSO, resulting in a large-scale smart grid in a district that manages renewable energy production, energy consumption and storage. Another example is the **P2P-SmartTest** project, which aims at employing Peer-to-Peer (P2P) approaches to ensure the integration of demand side flexibility and the optimum operation of distributed energy resources within the power network. In this project, an energy services provider collaborates with universities, research centres, ICT companies and the local DSO. One of the objectives is to come up with possible business models for energy services providers, and also for DSOs as will be presented in the next section.

Finally, the last category of non-traditional stakeholders refers to the 61 *municipalities* and other local authorities involved in the LEC projects (Figure 3). These organisations have been identified as relevant local actors in the development of LEC, and 31 out of 72 projects include at least one of them (Figure 2). We have already discussed the participation of municipalities in some of the projects above, however the role of local authorities in the energy transition is more evident in some other projects. In the **CITyFiED** project, for example, three municipalities collaborate with other emerging stakeholders, universities, consultancies, etc. to create a replicable, systemic and integrated strategy to adapt European cities and urban ecosystems into the smart city of the future. The project aims among others in delivering three holistic district renovations in Spain, Sweden and Turkey. However, during the project lifetime a cluster of 11 cities closely connected to the project consortium has been formed, to maximize the replication potential of the project results. Moreover, a wider community of interest of 40 cities has been created, with the scope to benefit from networking activities with other municipalities and communities and information sharing. Similarly, in the project **SINFONIA** two municipalities from Italy and Austria have been working hand in hand to achieve primary energy savings and increase the share of renewables in two pioneer districts. At the same time through collaboration with other private and public stakeholders they try to ensure the scalability and transferability of their solutions in another five early adopter cities in Cyprus, Germany, Spain, France and Sweden. In other projects, municipalities present a more passive role. For example, in the project **CITINES**, municipalities only have the role of the end user of the final project result, which in the specific case is, a decision-support software tool dedicated to help local authorities to design and monitor their energy action plan.

DISTRIBUTION SYSTEM OPERATORS SUPPORTING ENERGY COMMUNITIES

Distribution system operators as neutral market operators play a fundamental role in empowering customers, either individually or collectively participating in electricity markets.
Engaging customers in collective energy initiatives can further promote electric mobility, renewable generation uptake and energy savings, and as such facilitate the process of energy transition.
DSOs may play an enabling role in the development and operation of local energy community by provision of various grid infrastructure services, but also use different services provided by the local energy community (e.g. flexibility) for cost-effective grid expansion and/or operation. In this respect, we observe significant number of community-oriented projects in our database where DSOs partner with local authorities (30 out of 72 projects include at least one DSO, with 13 of them including also an emerging stakeholder). In total 35 different DSOs participated in these 30 projects, out of which 12 had the role of the project leader.
Further in this section we briefly analyse few examples of such projects.

Accelerating Renewable Connections project addresses the role communities play in accelerating renewable connections by matching locally produced generation with local energy demand. In this regard, the DSO leading the project aims at improving network access and capacity available to accommodate distributed generation, by active network management, and provision of flexible connection arrangements, where generators are requested to modify the amount of energy they produce to meet local electricity demand and respond to network constraints. To achieve this, the local DSO collaborates with a local charity organisation Community Energy Scotland, among others, to actively engage electricity customers to proactively manage the flow of energy on the local network.
The project resulted in improved network access and capacity available to accommodate distributed generation, facilitated connection of distributed generation in areas with electricity network constraints, accelerated generation connection times and reduction of connection costs.

Similarly, another DSO in UK partners with Durham County Council in the community project **Activating Community Engagement** which investigates the potential of residential customers in providing demand response services to the distribution network operators. The customers are engaged through an online platform, developed in the project, which allows the DSO to disconnect a load remotely in exchange of some sort of rewards. In this way, participants earn points for load reduction at certain times which can be converted to cash for a chosen community group or individual participants. Such services are expected to facilitate the growth of decentralised renewable energy sources, whilst keeping costs down for customers by deferring or avoiding the need for network reinforcement.

Another interesting project in this regard is the **P2P-SmarTest**, which explores innovative market arrangements for peer-to-peer energy trading at community level and discusses possible DSO business models. Effective involvement of customers in such energy trading schemes requires large-scale deployment of smart metering infrastructure, which in most Member States is installed, managed and operated by the DSOs.
Moreover, P2P energy schemes facilitate the provision of flexibility services provided to the DSOs to resolve network constraints and optimize network availability in more cost-effective manner. The project further discusses possible DSO business models by allowing the DSOs to manage a "portfolio of network services" rather than "managing assets". Such services can vary from energy transport (electricity to final consumers, feed-in electricity from distributed generation and charging of electric vehicles), access services, retail market facilitation and system operator services.

CONCLUSIONS

This work has investigated if the policy discussion and current interest in local energy communities is reflected in European smart grid pilot projects. The analysis, based on the JRC smart grid projects database, reveals a trend towards an increasing involvement of non-traditional players in pilot projects that employ a community-oriented approach. An increasing number of non-traditional players, such as municipalities, housing associations, etc. are involved in local energy initiatives. They are valuable actors for consumer engagement and project success, since they benefit of a high level of trust and knowledge of the local environment. They are also starting to partner with DSOs, whose enabling role in the development and operation of local energy communities emerges from the present analysis.

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