Guidelines for successful social innovations in the energy sector

Authors: Iban Lizarralde, Michael Hamwi, Audrey Abi Akle, Basma Samir (ESTIA), Alexandru Costeniuc (TRACTEBEL), Nuno Brito (GoParity), Jakob Hoffmann, Joscha Gretzschel, Andreas Schneller (Adelphi)

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WIP Renewable Energies coordinates the SocialRES project.

The consortium involves 13 partners in 9 European Countries. The logos of the partners cooperating in this project are shown below and information about them is available in this report and at the website: www.socialres.eu

This report has been written by Iban Lizarralde, Michael Hamwi, Audrey Abi Akle, Basma Samir (ESTIA), Alexandru Costeniuc (TRACTEBEL), Nuno Brito (GoParity), Jakob Hoffmann, Joscha Gretzschel, Andreas Schneller (Adelphi). The authors thankfully acknowledge the valuable contributions from all project partners.

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Contacts

Project coordinator

Silvia Caneva
WIP – Renewable Energies
Sylvensteinstrasse 2, Munich, Germany

Email: silvia.caneva@wip-munich.de
Email : sonja.wilhelm@wip-munich.de

Author(s)

Iban Lizarralde, Michael Hamwi, Audrey Abi Akle, Basma Samir (ESTIA), Alexandru Costeniuc (TRACTEBEL), Nuno Brito (GoParity), Jakob Hoffmann, Joscha Gretzschel, Andreas Schneller (Adelphi)

Reviewer(s)

Silvia Caneva (WIP)

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Introduction

The main outcome of this document is a guideline tool for social innovation initiation in the energy sector: The SOGUI framework.

This framework is the result of different guidelines presented in the document based on specific suggestions and preconditions for renewable energy aggregators, cooperatives, crowdfunding platforms, and other socially innovative organisations in the energy sector.

The document is organised as follows.

Section 2 focuses on Citizen Energy Communities and the Renewable Energy Communities.

Specific steps are listed to launch Energy Communities which prefigures the guideline tool. A particular focus is done for energy cooperatives and crowfunding platforms. Moreover this section is underpinned with real examples.

Even if municipalities and local governments are encouraged to joint Energy Comunities, this specific topic has been treated in section 3. This section enumerates the most stated suggestions for practices that support local authorities to develop means to get closer to citizen initiatives.

Section 4 focuses on two actors that can be part of social innovations in the energy sectors but have not been treated in former sections. The goal is to present a guideline for effective aggregator and P2P platform development. A focus is done on the preconditions to launch a local aggregator based on the activities of an independent aggregator. Then, the focal point is centred on peer-to-peer electricity trading tools and the steps to launch a P2P platform. The TEAP energy virtual trading platform is presented as a useful example.

Lastly, section 5 gathers the main suggestions and formalises a useful framework (the SOGUI framework) for actors that are willing to launch a social innovation in the energy sector. A specific section details the ownership models in the energy sector. Then the the SOGUI framework is presented in detail, explaining how to use this guideline tool.

1. From barriers and requirements to a guideline for social innovation in the energy sector

1.1. How to overcome the barriers within energy, aggregators coops and crowdfunding platforms

The main goal of this document is to present some guidelines to foster social innovations in the energy sector. These guidelines are based on suggestions and preconditions that are grounded on the analysis of related drivers and barriers for successful socially innovative organisations carried out at the beginning of the SocialRES project. These guidelines are useful for renewable energy aggregators, cooperatives, energy communities, crowdfunding platforms, and other socially innovative organisations in the energy sector that are planning to launch a new project or would like to develop their organisational and financial strategies.

Within the SocialRES deliverable "Characterisation of driving factors for social innovations", the main barriers to launch a social innovation in the energy sector were presented: lack of funding, passivity in society, administrative and bureaucratic barriers, absence of legal framework, lack of access to information needed, deficiency of society to open up the experience of other groups, lack of experience in carrying out social innovation projects and passivity and low level of stakeholder support.

One of the main barriers was the "passivity in society", showing the difficulties in the upstream phase to launch a social innovation in the energy sector.

In this document, accurate suggestions and preconditions have been listed to overcome these barriers.

These suggestions and preconditions have been obtained from the experience description of the different cases of the SocialRES project. These suggestions have been listed taken into account the main motivations that were identified in the SocialRES deliverable "Characterisation of driving factors for social innovations". Indeed, focusing on the motivations allows to better define the guidelines that will foster different stakeholder to integrate the Energy communities.

As reminder the motivation identified were classified as follows:

- Individual Goal oriented (Self-interested)
- Personal development Motivation
- Economical Motivation (material payoffs)
- Communal Goal oriented (based on Social norms)
- Political Motivation
- Territorial Motivation
- Ecological Motivation
- Form/practise oriented
- Social relationships Motivation

1.2. Requirements for social innovation in the energy sector

Traditionally, energy systems have been centralized, monopoly-like structures. Due to the underlining fossil fuel-based technology, energy production used to be only viable for large companies, as power plants require huge upfront investments and operation expenses. Therefore, most energy systems used to be characterized by a one-way relationship between consumers and producers of energy, with both parties being clearly distinguishable from another (Al-Sunaidy and Green, 2006).

However, the traditional set up of energy systems are changing around the world due to two interconnected developments. On the one hand, technological innovation has led to the advent of renewable energy sources. On the other hand, this has enabled social innovations with consumers becoming active participants in the energy grid. In contrast to traditional fossil fuel power plants, renewable energy production can be viably operated at very small scales. Due to their smaller scale, renewable energy sources require a greater number of individual productions sites (Vezzoli et al. 2018). This makes it viable for private households to become active participants in the energy system, i.e. by co-financing renewable energy projects via crowdfunding platforms or becoming involved with a local energy community. Most importantly though, consumers can become energy producers themselves. By decking out one’s rooftop with solar panels for example, former consumers can become energy producers themselves – the so called prosumership (Szulecki, 2018).

The potential of prosumership is vast, with some experts estimating that 25% of local energy needs could be supplied this way (Hoffmann et al., 2021). Furthemore, the rise of prosumership opens up the door to downstream social innovations in the energy sector that require a flexible energy grid with many active participants. This is the case for energy aggregation. Energy aggregators are companies that pool the consumption and production capacities of a large number of distributed energy sources. These can be private households or businesses that connectedly act as a virtual power plant. Ideally, the aggregated actors supply energy when the grid experiences high electricity demand and consume energy in non-peak demand times. This can make the energy grid more stable and efficient, and less reliant on peaking fossil fuel plants (IRENA, 2019).

Realizing the potential of these developments depends on the active involvement of citizens in the energy system. In SocialRES, the project team identified three key areas how citizen involvement can be further supported in a democratised energy system: municipal involvement, appropriate financial mechanisms, and citizen ownership targets.

Municipal involvement can be beneficial in multiple ways. Social innovations in the energy sector are often initiatied by citizens themselves. They come together and organise themselves to initiate projects that target municipally owned areas. This includes rooftops of publicly owned buildings, fields or similar public spaces. For these projects to be sucessful, the targeted municipalities must cooperate with the social innovators and project sponsers to enable the use of public property. The municipal support for social innovations in RES can be a mutually benefical for both the socially innovative project as well as the municipal government. Energy communities are a good example. On the one hand, energy communities can rely on support by the involved municipality for legal matters and navigation of bureaucratic requirements. Municipal support for a social innovative project also lends legitimacy to the project, acting as a stamp of approval for investors. This not only applies to energy communities, but also crowdfunding projects (Hoffmann et al., 2021).

On the other hand, local municipalities can also benefit from their involvement in energy communities (ECs). For one, direct involvement of the local authority in a community-led project strengthens the ties of the local government with their electorate. Furthermore, the governance structures of ECs often allows local municipalities a vote in decisions of who is awarded the project development, opening the door for smaller, local SMEs to get involved as well. This is not always the case however. Many countries still employ legislation that unintentionally restricts municipal involvement. Countries like the UK and Croatia base procurement of public projects only on cost criteria (Hoffmann et al., 2021). As a result, projects are often awarded to large project developers instead of socially innovative projects from which the local population would likely benefit more. These legislative barriers must be dismantled for social innovations in the energy sector to thrive.

The second lever that can promote citizen involvement in energy system is the design of financial mechanisms. For most innovations, economic viability must be ensured to make long-term success possible. This also applies for social innovations in the renewable energy sector. Citizens cannot be expected to become prosumers as a philantropic interest, there is the need for economic incentives as well. Cleverly designed financial mechanisms can increase the demand for installations of renewable energy sources, encouraging citizens to become prosumers or otherwise active players in the energy system. A popular example of financial mechanisms that facilitate this development are feed-in tariffs. They guarantee households that produce excess electricity through solar panels (or other renewable energy sources) a certain price, often above-wholesale market. This scheme was popular in many European countries, but guaranteed prices were continously lowered in recent years (Hoffmann et al., 2021). Alternative financial mechanisms include tax breaks for installations of renewable energy sources, favorable loan conditions or even direct grants.

Municipal involvement and the design of financial mechanisms encourage citizen participation mostly by dismantling existing barriers or in centivising RE installation through a bottom-up approach. However, authorities can also choose a somewhat bolder, top-down approach to citizen involvement by setting national and regional citizen ownership targets for RE generation. With this policy, governments set targets for total capacity or a percentage of renewable energy sources owned by private citizens. These goals are then often accompanied by policies such as the ones described above to facilitate the uptake of private RE generation or other forms of citizen involvement in the energy system. Examples of the implementation of citizen ownership targets are the Netherlands, where the national government has declared the goal of 50% citizen ownership of renewable energy sources by 2030. Similarly, the Scottish government aims to have 2GW of RE capacity to be community-owned by the same year (Hoffmann et al., 2021).

To realize the full potential of the energy transformation, active citizen involvement is crucial to facilitate social innovations in the energy sector. With municipal involvement, financial mechanisms and citizen ownership targets, governments have powerful tools available to promote the needed citizen involvement.

2. Guidelines for effective Renewable and Citizen Energy Communities

2.1. The Citizen Energy Communities and the Renewable Energy Communities.

The “Clean energy for all Europeans” package, has inaugurated the Citizen Energy Community and the Renewable Energy Community concepts.

The directive on common rules for the internal electricity market ((EU) 2019/944) take account of specific rules to facilitate the investment by new stakeholders. It also supports an active participation of end-users in the energy domain through Citizen Energy Communities, in the electricity usage scope. This includes the generation, the consumption and different mechanisms for electricity sharing.

The active participation of end-users is also supported by the Renewable energy directive (2018/2001/EU). In this case, the scope of renewable energy systems can include technics that are not based on electricity. Wood based heating systems for example can be developed taking into account the whole value chain within the Renewable Energy Communities.

Both Energy Communities allow end-users, municipalities, and SMEs to actively participates in the development of renewable source projects and the deployment of new energy services, flexibility services or energy sharing schemes. The main characteristic of an Energy Community is that it gathers actors involved in an energy project that is situated in a geographic area or actors with a common field of interest working in a larger scope.

There are many benefits brought from Energy Communities:

- Energy efficiency and energy savings.
- Financial gains for end users, municipalities and at national level.
- Enhance comfort for end users.
- Develop local employment
- Fight energy poverty by specific price mechanisms and energy efficient buildings
- Support social and community development
- Empower citizens and build capacity.

These directives are currently being transposed into national law. Therefore, the are still limitation to develop new energy services and performance-based contracts. These limitations vary from one member state to another. In some cases, the legal entity and the scope of the stakeholders that can participate in these new energy services and performance-based contracts is not clearly defined. Moreover, economic and fiscal barriers limit the deployment of original business models. Finally, energy communities are limited to participate in some energy markets that could increase the revenue models of the business model.

In order to encapsulate the recommendations and preconditions for launching an Energy Community, in the section 5 the SOGUI framework will be presented. This framework is built as a process that can be use as a guideline to begin energy projects involving citizens willing to improve energy efficiency, sustainability and affordability.

2.2. The role of energy cooperatives within Energy Communities

Cooperatives are neither non-profit organizations nor only economic oriented companies. They are enterprises that do not follow an equity-based proportion for decision making but the one-member-one-vote principle. Indeed, their values go further than only economic aspects. Co-operatives are founded on the "values of self-help, self-responsibility, democracy, equality, equity and solidarity. In the tradition of their founders, co-operative members believe in the ethical values of honesty, openness, social responsibility and caring for others".

In the deliverable "Comparative analysis of existing business models for RES cooperative, aggregators and crowd-funders" of the SocialRES project, the seven principles of the cooperatives have been revisited following the definition of the International Cooperative Alliance and comparing with the terms used to define the Renewable Energy Community (REC) in the Directive (EU) 2018/2001 (RED, 2018).

The main outcome is that most of the principles of cooperatives and Energy Communities have the same baseline. This is visible mainly on the participation aspects: An Energy community "is based on open and voluntary participation, is autonomous, and is effectively controlled by shareholders or members that are located in the proximity of the renewable energy projects that are owned and developed by that legal entity". But also in the governance aspects: An Energy Community "should be capable of remaining autonomous from individual members and other market actors that participate in the community as members or shareholders, or who cooperate through other means such as investment".

Beyond the participation of cooperatives in Energy Communities, the new legal framework encourages the collaboration with local authorities: "the shareholders or members of which are natural persons, SMEs or local authorities, including municipalities". This specific issue is developed in the subsection 3 "Guidelines for partnership with local authorities".

Energy Communities can have another juridical status depending on the legal framework of each state member.

Globally, in order to launch an Energy Community, three main steps are followed: Understand, plan and act.

Generally, Energy Communities begin by getting in touch with other energy communities or cooperatives. This learning process allow a transfer of local energy projects dos and don'ts. This step is also an opportunity to know better the different solutions that are accessible in the market. In this state, usually the overall energy project scope is defined, and the necessary skills identified. The community can rarely adopt several activities at the same time. Even if several activities can be launch if there are synergies and are part of the same market activities, it is exceptional to launch a community working at the same tine in an electric retailer company, renewable electricity generation project or a renewable thermal project. The first member group is created who can decide to define a clear statement about the goals and the democratic practices of the Energy Community.

The plan phase allows to define the project. Define better the technology that will be applied and the geographic spaces that could be used for the project if needed. Moreover, in this phase the participant stakeholders are defined and the relationship with local authorities stated. The governance model needs to be outlined clearly, as well as the first financial models in order to launch the initial projects. Beyond renewable energy projects, the community can stablish other goals like energy efficiency, energy poverty fighting, etc.

Lastly, the real Energy Community emerges when first actions are accomplished. First funding campaigns are performed, and first project can now be visible. Moreover, the legal status is clearly stablished. This ongoing phase will define the location and the scale of the projects as well as the capex needs of each project. Moreover, the type of business models is usually defined in an “on-going” process. In some cases, relationship with public authorities can depend on each project while in some Energy Communities, the local authority is an active member of the structure. Skills and competences are better defined during this phase and in some cases a professionalisation process could emerge.

The following section describes an accurate project identified by the portuguese partner of SocialRES, GoParity, who supports multi building collective self-consumption business models in collaboration with the energy cooperative Coopernico.

2.3. The multi building collective self-consumption business model

The collective self-consumption project of the Condominio da Torre – Malha 15.3, located in Lisbon, is a pilot under the scope of the H2020 project COMPILE that kicked off in 2018. The overall objective of this European funded R&D project is to show the opportunities that Energy Communities offer to decarbonize energy supply while creating stronger local communities and socioeconomic benefits to the society. Including Lisbon pilot, there are a total of 5 sites around Europe – Slovenia, Spain, Croatia, Portugal and Greece – that are being implemented and studied by the COMPILE consortium formed by 13 European partners and with a collaboration of 2 international entities from India and China.

The Condominio da Torre – Malha 15, 3 already is located in Lisbon and it is formed by 8 buildings that host around 150 apartments and 8 small shops. Before joining COMPILE, the condominium already had 8 individual self-consumption systems (solar photovoltaic installations) feeding the buildings’ common areas. Under the scope of the COMPILE project, Coopérnico has worked in close collaboration with its tenants to expand the current solar photovoltaic installations to create a system that could directly feed each apartment of the multi-building condominium, therefore initiating a collective self-consumption initiative. Back in 2018, in Portugal there was no law to regulate collective self-consumption schemes. The Portuguese legislator has started the transposition of the EU framework introducing RECs and collective self-consumption schemes in the Decree Law 162/2019 from October 2019. With this first legislation, the Portuguese government renewed the previous regulatory framework on individual self-consumption introducing the concepts of Renewable Energy Communities (RECs) and Collective Self Consumption (CSC). Both solutions require: (1) an internal regulation that needs to include at least basic management and sharing rules (for self-consumption and potential revenues); (2) an entity responsible for the operational management of the self-consumption activities and the communication with the respective operators; (3) a responsible technician.

Currently, the condominium has not finalized yet the process to become a fully operating collective self-consumption, but major steps ahead have been achieved:

- The condominium has approved in general assembly the willingness to establish a collective self-consumption scheme by expanding the currently installed solar photovoltaic system with its own financial resources;
- The condominium administration have already accepted a proposal to start the expansion of the solar photovoltaic system;
- All the major requirements to finalize the registration of the collective self-consumption scheme – internal regulation, the definition of an entity responsible for the operations and a responsible technician – have already been defined and only few details, such as key personal information from a part of the tenants, are missing.

The Condominio da Torre – Malha 15, 3 is planning to install, in the long term, a total new solar photovoltaic capacity of 57 kWp that will be added to the existing 16 kWp, currently used for self-consumption purposes for the common areas of the 8 buildings forming the condominium. As stated before, it has already been approved in general assembly to go forward with this initiative and the next step will be to install an extra 10 kWp. Further expansions will follow in the coming years.

Coopérnico role was key to:

- Perform techno-economic analysis to evaluate the feasibility of the project;
- Coordinate the communication with the tenants and collaborate with them to fully understand key evolution in the national legislation;
- Develop a shared internal regulation with the aid of a more active part of the tenants that could be comprehensive and fair for all the participants.

Coopérnico is convinced that the Condominio da Torre – Malha 15, 3 would be the first of many other condominium collective self-consumption schemes, another example to show how citizens can positively contributed to shift towards a cleaner energy system, delivering positive environmental, social and economic impacts.

2.4. The role of crowdfunding platforms within Renewable Energy Communities

In the deliverable “Comparative analysis of existing business models for RES cooperative, aggregators and crowd-funders” of the SocialRES project, different types of crowdfunding were presented: Debt-based crowdfunding (crowdinvesting), equity-based crowdfunding (crowdlending) which includes invoice trading and non-investment models (Crowdfunding without an economic return for investors) which includes reward-based crowdfunding and donation-based crowdfunding.

Renewable energy crowdfunding platforms are usually debt-based or equity-based crowdfunding. Generally, debt-based crowdfunding has less risk and investment duration is shorter than equity-based crowdfunding. But the later can have higher returns (Bonzanini, Giudici and Patrucco, 2016; Lam and Law, 2016; De Broeck, 2018).

Based on the analysis of this deliverable and the document "How to set up and run a crowdfunding platform – legal, financial, fiscal and exit issues" (Simons Muirhead & Burton LLP), key preconditions and requirements have been listed to include a crowdfunding service within an energy community.

Moreover, the launching of the Regulation on European Crowdfunding Service Providers (ECSP) for business, the (https://ec.europa.eu/info/business-economy-euro/growth-and-investment/financing-investment/crowdfunding_en), open new opportunities for crowdfunding platforms development in a transnational level. The regulation lays down uniform rules across the EU for the provision of investment-based and lending-based crowdfunding services related to business financing. It allows platforms to apply for an EU passport based on a single set of rules, which makes it easier for them to offer their services across the EU with a single authorisation.

The details of the regulation are described in the following paragraphs.

Regulation (EU) 2020/1503 of the European Parliament and of the Council of 7 October 2020 on European crowdfunding service providers for business, and amending Regulation (EU) 2017/1129 and Directive (EU) 2019/1937 (http://data.europa.eu/eli/reg/2020/1503/oj). The regulations will support energy projects seeking alternatives to bank financing. Investors on crowdfunding platforms will benefit from an aligned and enhanced investor protection framework, based on rules for project owners and crowdfunding platforms on governance and risk management for crowdfunding platforms.

Regulation (EC Europa, 2020) on European Crowdfunding Service Providers (ECSP) for business, the (https://ec.europa.eu/info/business-economy-euro/growth-and-investment/financing-investment/crowdfunding_en). Basic choices for launching a crowdfunding platform include the choice of the legal structure and the different investment models. There are three types of crowdfunding systems: Debt-based crowdfunding (crowdinvesting), equity-based crowdfunding (crowdlending) which includes invoice trading and non-investment models (Crowdfunding without an economic return for investors) which includes reward-based crowdfunding and donation-based crowdfunding

The terms "Alternative finance", "Peer to Peer Lending" and "crowdinvesting" are often used to refer to the Equity and Loan models, indicating that the investor expects or, at least, hopes to receive a financial return on its money (Simons Muirhead & Burton LLP). Concerning the choice of the legal structure four solutions have been identified: a Limited Company, a Limited Liability Partnership (LLP), a Partnership or a Cooperative Society. Each legal structure will have different management structure and will have to respect specific taxation rules. Some European crowdfunding platforms have launched their activities based on a European Cooperative Society (SCE). The SCE is an optional legal form of a cooperative. It aims to facilitate cooperatives' cross-border and trans-national activities. The members of an SCE cannot all be based in one country. Ref (European Cooperative Society (SCE)) (https://ec.europa.eu/growth/sectors/social-economy-eu/cooperatives/european-cooperative-society-sce_fr).

3. Guidelines for partnership with local authorities

Several good practices of energy democracy in Europe are the result of an efficient collaboration between citizen initiatives and local authorities. Actually, EU legislation encourages local authorities to become members and shareholders of energy communities, together with their citizens and local SMEs, without taking full control of the structure(Friends of the Earth Europe, REScoop.eu and Energy Cities, 2021).

Even if there is no specific process for these kinds of collaborations, the following suggestions can support these practices. This list is not exhaustive, it has emerged from the workshops organised with the use cases of the SocialRES projects. It is also based on the recommendations proposed by (Haf and Robison, 2020). Moreover, two European networks are especially dynamic encouraging and supporting this kind of collaborations. On one hand, Energy Cities supports local authorities with recommendations and develop specific means to get closer to citizen initiatives. In the document (Energy Cities, 2019) is a good example of these means. On the other hand RESCOOP has also listed some recommendations to work with municipalities (Friends of the Earth Europe, REScoop.eu and Energy Cities, 2021).

The following list gather the most stated suggestions for these practices:

- Promote the participation of citizen and understand the ethics of this participation.
- Support citizen-led initiatives and engage with existing projects is important as answers often lie within their communities, and that citizens are already participating in energy systems.
- Share common objectives : Environnemental, social, etc.
- Local and regional authorities shall adopt long-term objectives related to energy production, such as a specific target to quantify community-owned renewable production capacity.
- Local authorities can buy locally generated renewable energy from community energy projects.
- Implementing a collaborative approach to delivering the energy transition by offering resources, officials’ time, guidance and a more united relationship between communities and Local Authorities.
- Local Authorities can raise projects’ visibility and recognition through raising awareness amongst their own members of staff and between departments of the benefits of citizen participation in the energy transition. Local Authorities can also use their established relationship with local and national media, to highlight the initiatives that occur within their region.
- Local and regional authorities can adopt specific land-use or buildings-related regulations that favour the development of citizen or community-owned energy sources.
- Community or citizen ownership of energy initiatives developed by local authorities means citizens are better able to engage with energy systems. Ownership can involve financial stakes in community energy initiatives and

municipalisation movements and the co-design (and a sense of co-ownership) of energy visions and projects through deliberative processes.
- Exemplarity of the local authority. Exemplarity of municipality’s projects and infrastructure, training of employees of the local authority.
- These employees can be allocated to support with specific skill the project initiated by citizens.
- Local and regional authorities can be crucial in providing guarantees for financial institutions when citizen initiatives have difficulties to access to credit.
- More cross-departmental collaboration within Local Authorities, including an understanding of energy transition matters going beyond being an ‘environmental’ issue alone.

4. Guidelines for effective Aggregator and P2P platform development

Section 4 focuses on two actors that can be part of social innovations in the energy sectors but have not been treated in former sections. The goal is to present a guideline for effective aggregator and Peer to Peer (P2P) platform development. A focus is done on the preconditions to launch a local aggregator based on the activities of an independent aggregator. Then, the focal point is centred on peer-to-peer electricity trading tools and the steps to launch a P2P platform. The TEAP energy virtual trading platform developed by Tractebel during the SocialRES project is presented as a useful example.

4.1. Preconditions to launch a local aggregator

The European Union, as part of the Clean Energy for all Europeans package, opened the market for independent aggregators, seeking to establish them as legitimate market actors able to operate on both wholesale and ancillary markets. With a new and strengthened legal position, the number of independent aggregators has steadily increased but has so far failed to truly break into the mainstream. As of 2019, 26 prominent independent aggregators are operating around Europe, this number is expected to grow in the coming years (Poplavskaya and Vries, 2020). For this number to grow, certain regulatory and technical preconditions must be fulfilled to ease market entry for independent aggregators. This section will look at some regulatory prerequisites in both the wholesale and ancillary markets as well as some technological prerequisites for the launching and successful operation of independent aggregators.

The first step is to look at are the activities of an independent aggregator, as these will determine the prerequisites that must be in place for its effective launch and functioning. Independent aggregators aggregate distributed energy resources (DERs) into a virtual power plant (VPP). These DERs can range from household level production units like private rooftop PV, to flexible consumption or storage units like heat pumps and electric vehicles (EVs), but can also include small to medium sized RE installations like solar farms. Via centralised software, these units come together to act like a single power plant (the VPP) – offering production, consumption (demand response), or both – that can participate in electricity markets and compete with larger generating units. There are several markets that independent aggregators can participate in. Each of these comes with a set of requirements that the independent aggregator must meet in order to participate. These vary between countries.

The EU has addressed the issue of market participation by aggregators, especially in offering demand response, in Article 17 of the IEMD which states that member states shall enable “each market participant engaged in aggregation, including independent aggregators, to enter electricity markets without the consent of other market participants”(Article 17 3b Directive (EU) 2019/944). The following sections look at different markets that aggregators can enter and some of the requirements to do so.

1. Wholesale electricity markets (Day-ahead, intraday)

In this model the independent aggregator offers electricity to retailers or other actors on the electricity exchanges through the auction system for day-ahead trading. The only difference here between the independent aggregator and a traditional generator is that the electricity from the independent aggregator is generated by DERs. Joining an independent aggregator allows DERs to be competitive on the wholesale market, providing them with higher profits through the option of submitting larger bids as a group. Participating as part of an aggregator also reduces the risk of a failure to deliver the electricity due to forecast errors that an individual small generator faces.

The intra-day market offers additional opportunities to independent aggregators to generate revenues and profits. They offer an opportunity for aggregators to adjust the energy they are selling on a given day, for example if more than expected is produced by the DERs. Alternatively, they can use the intra-day market to buy back the energy they sold on the day ahead market if the adjusted forecasts show they would not be able to deliver it (Naval and Yusta, 2021). Intra-day markets can also be used to charge storage assets when prices are low enough to make this economical.

The regulatory framework for the day-ahead and intra-day markets vary greatly from country to country. Participation can be dependent on minimum bid sizes and minimum and maximum prices. Until recently some EU countries did not have competitive electricity auctions and all electricity was traded exclusively through bilateral agreements (European Commission and Frontier Economics, 2016). The largest wholesale market in the EU, the EPEX SPOT wholesale market, already allows for the participation of aggregators, and lists a number of them under its exchange members (EPEX SPOT, 2021). The requirements for participation are also defined by the exchange. These include a registration process for companies and an exam for the designated traders who will trade on behalf of the registered company. The registered company must then become a balance responsible party and find a clearing bank – or sign a clearing contract directly with the European Commodity Clearing AG (ECC) (EPEX SPOT, 2021). Once these steps are completed, the newly registered aggregator can start trading.

2. Balancing markets / Ancillary services

Balancing markets are well suited as a venue for independent aggregators to compete in as their flexibility, due to consisting of many DERs, gives them an advantage in competition here. Most commonly, auctions in balancing or reserve capacity markets are run by the TSOs. Participants receive a price per hour of availability as well as a price per MWh if the capacity is deployed. Schittelkatte et al. (2021) point out some of the major barriers independent aggregators face when competing on balancing markets. Firstly, many EU countries simply do not yet allow bidding with a pool of assets in the balancing markets (as of 2018), rules like this explicitly exclude independent aggregators from participating on the balancing markets. This, however, is being addressed by the EU which in Recital 39 of the IEMD state that aggregators should be allowed to participate in all electricity markets, including ancillary services, and thus balancing markets for countries where balancing energy is obtained via auction markets. Secondly, prequalification of generation units is a major barrier that independent aggregators face. In some aggregators cannot go through a prequalification process as a VPP, but rather every individual DER must pass a formal prequalification. This can be prohibitively expensive for aggregators and represents a major barrier (Schittelkatte et al., 2021).

Aggregators have the opportunity to engage in both positive and negative balancing. Engaging in positive balancing means the DERs would increase generation and/or decrease consumption. In negative balancing the DERs would decrease generation and/or increase consumption. However, there are national differences here, for example some countries only allow generators to participate in the balancing markets and thus only decreased or increased generation is possible for balancing, some countries allow both demand response and generation, but not as a combined product (European Commission and Frontier Economics, 2016; SmartEn, 2018). Country differences are also present in the participation requirements such as minimum bids (in MW) where there are auctions, very high minimum bid thresholds can be a significant barrier for aggregators (SmartEn, 2018). Minimum time in which the capacity can be made available is also important, this is determined on whether primary, secondary, or tertiary control reserve is being offered. The type of control reserve being sold also comes with additional requirements such as minimum and maximum activation time spans. All these are important considerations for aggregators when deciding what market to participate in and what product to offer.

3. Power Purchase Agreements (PPAs)

Power purchase agreements allow aggregators to directly sell their generated electricity to a utility or a private company. This is a bilateral agreement between the two parties, thus there are no generally identifiable barriers here. The prerequisites of a PPA such as delivery amount and time of delivery are decided privately by the buyer and seller in the procurement contract. PPAs offer aggregators stability and reduced exposure to market risks such as price volatility. Article 21 of the REDII grants renewable self-consumers the right to sell their excess renewable energy individually or through aggregators via PPAs (Directive (EU) 2018/2001).

Technical Prerequisites

While there are plenty of options for aggregators to participate in electricity markets, as discussed above, the most important barrier still remains the technical feasibility of operating a mass consumer aggregator. The reason large and established aggregators mainly aggregate large industrial load and medium to large sized DERs is because the technical requirements are hardly met at the household level (Schittekatte, Reif and Meeus, 2021). Aggregators can effectively function as intermediaries, and their software reduces information and coordination costs on both the market side and the DER's side. However, this coordination still relies on high quality granular information which can only be provided by smart meters, of which the rollout is still underway. On the supply side, the EU is on a strong path. As of 2018, 19% of the total PV system capacity was installed on residential rooftops, although this number varies greatly between countries (Schmela, 2018). As feed-in-tariffs for household prosumers are phased out or become less economically attractive, joining an aggregator may present itself as an attractive opportunity to continue to generate positive returns from residential rooftop PV. The demand and flexibility side is less developed, in 2019 only 7% of residential solar PV installations were coupled with a battery storage system (EES, 2020). However, flexibility will also come from the adoption of other technologies and broader sector shifts such as an increase in EVs and the electrification of the heating sector through heat pumps.

Aggregators will benefit from scale as they can aggregate more generation units and loads from a wider pool (Poplavskaya and Vries, 2020; Schittekatte, Reif and Meeus, 2021; Scott Burger et al., 2016). Reliable IT infrastructure is also essential, as communication breakdowns within the aggregator or VPP can lead to major disruption of the service. Beyond this time and experience will improve the software and algorithms, trading strategies and lower administrative costs making aggregators more competitive on the markets described above. Lastly, the regulatory landscape is improving in favour of aggregators, with harmonisation across the EU block towards open markets where aggregators can participate freely and compete without discrimination.

4.2. Guidelines to launch a P2P platform

4.2.1. Precondition and Requirement for participant involvement

The TEAP platform enables following participant categories: consumers, prosumers, small renewable energy producers and one strategic energy supplier. The present business model that Tractebel developed for the platform requires that participants should close contracts with the platform legal administrator and the platform should play the role of a software as a service for the involved parties.

In this way the participants would give up their classic energy supplier and embrace the possibility of buying/selling energy on the TEAP platform in a democratized manner, however without losing their supply security. This security is provided by the strategic energy supplier, who also plays the role of an energy aggregator.

The participants require minimal information and communication technologies knowledge. They should follow some basic “Sign In” steps in a browser in order to get an account generated and proceed energy trading. The platform is web based for now, being still a demo version, however in the future an app development could be taken into account.

A smart meter is needed so that the account can be used for energy market transactions. The smart meter activation can be easily made by the participation in her/his account, however this should be installed by a certified third party at the participant’s grid connection point and provided by the platform administrator, because for now the platform supports certain application interfaces.

There are no technical constraints regarding the renewable energy technologies (for example PV, wind, fuel cell, electric energy storage) of prosumers or small producers, however the forecast algorithm for the day ahead market energy transactions has been optimized for photovoltaics until now.

The challenge for the participant lies not in the technical requirements of the platform but in the energy transaction methodology. Before starting the energy transactions, one should thoroughly read the help details in order to get on overview of the rather complex transactional logic.

Even if the platform offers an autopilot mode, so that the participant should not engage actively in energy trading and focus mainly on results monitoring, it is recommended that every participant gets informed about the platform’s ‘way of thinking’. The core is about an energy forecast market, that brings all together on day ahead and intraday before energy delivery time, when the balancing market comes in to offset everybody’s account.

Some more technical oriented participants would rather engage theirselves in energy trading as compared to more humanistic participants. This requires some daily time, about 20 minutes, in order to generate the forecast for the day ahead, check once again its accuracy on the intraday market and perhaps engage in direct energy trading with other participants and last but not least monitor the energy trade results for the whole platform or individual.

One important thing to take into account is that TEAP needs some time to learn the participant’s energy profile based on the smart meter data and to improve her/his forecast. Therefore it is not worth to participate in the platform for a short period of time, because the forecast would not be accurate enough.

However ‘short time participants’ are unlikely to occur because the participation in the platform implies the change of the energy supplier and most people would rather do that on a medium-long term.

In autopilot mode there is no active involvement needed after signing in, no daily ‘waste’ of time. The disadvantage is that for now automatic energy trading is possible only on the Day-ahead market. If the participants want to improve the forecast or make better deals, they should manually engage on intraday.

Although TEAP is about energy trading, the participants should not necessary have knowledge about renewable energy or electricity. The trading object is a commodity as any other, expressed in other units, e.g. kWh. The trading logic or forecast patterns are more important and they don’t require energy know-how.

Even in autopilot mode the platform should generate a profit to the participant as compared to the classic consumer/prosumer - classic energy supplier scheme. The vast majority of the participants will most likely lack technical knowledge or interest in energy ‘deals’, so they would seek the platform for a better off with minimum engagement.

The preliminary results indicate that even in autopilot mode a certain profit is secured but this is also due to small energy quantities which are traded by ‘normal’ consumers or prosumers.

Participants seeking for bigger profits should study a bit the trading logic and either become member of a bigger group that aggregates the small individual energy quantities and can obtain better trading prices or engage manually in direct trading, if they can individually trade larger quantities.

4.2.2. The example of the TEAP energy virtual trading platform

The TEAP energy virtual trading platform offers an environment of interaction between Consumers, Prosumers, Small Energy Producers (RES) and a strategic energy supplier, within the local residential communities, for the purpose of electricity trading, through Day-Ahead Market (DAM) and Intra-day similar type markets.

For the purpose of analysis and forecasting, within the “Analyzer” module, historical information on consumption and energy supply will be taken from the users involved in the Tractebel project, the forecasts generated providing access to the energy trading market within the platform.

The platform also helps small energy producers (prosumers) by displaying energy demand on the DAM market; thus they will be able to estimate the amount of energy they will produce for the next day, as the storage costs of electricity produced on demand can be significantly reduced.

The use of this platform aims to promote for the final consumer the concept of package of integrated utility services, with an emphasis on renewable energy sources used, minimizing the purchase prices of energy in the market and especially the use of energy from renewable energy sources (RES), precisely to promote local ecological energy generation and a society as „green” as possible.

The platform is a web application that operates in an open-source software environment that has some basic components:

- OS
- Web Server
- DB Server: MongoDB
- DB Admin: MongoDB Compass

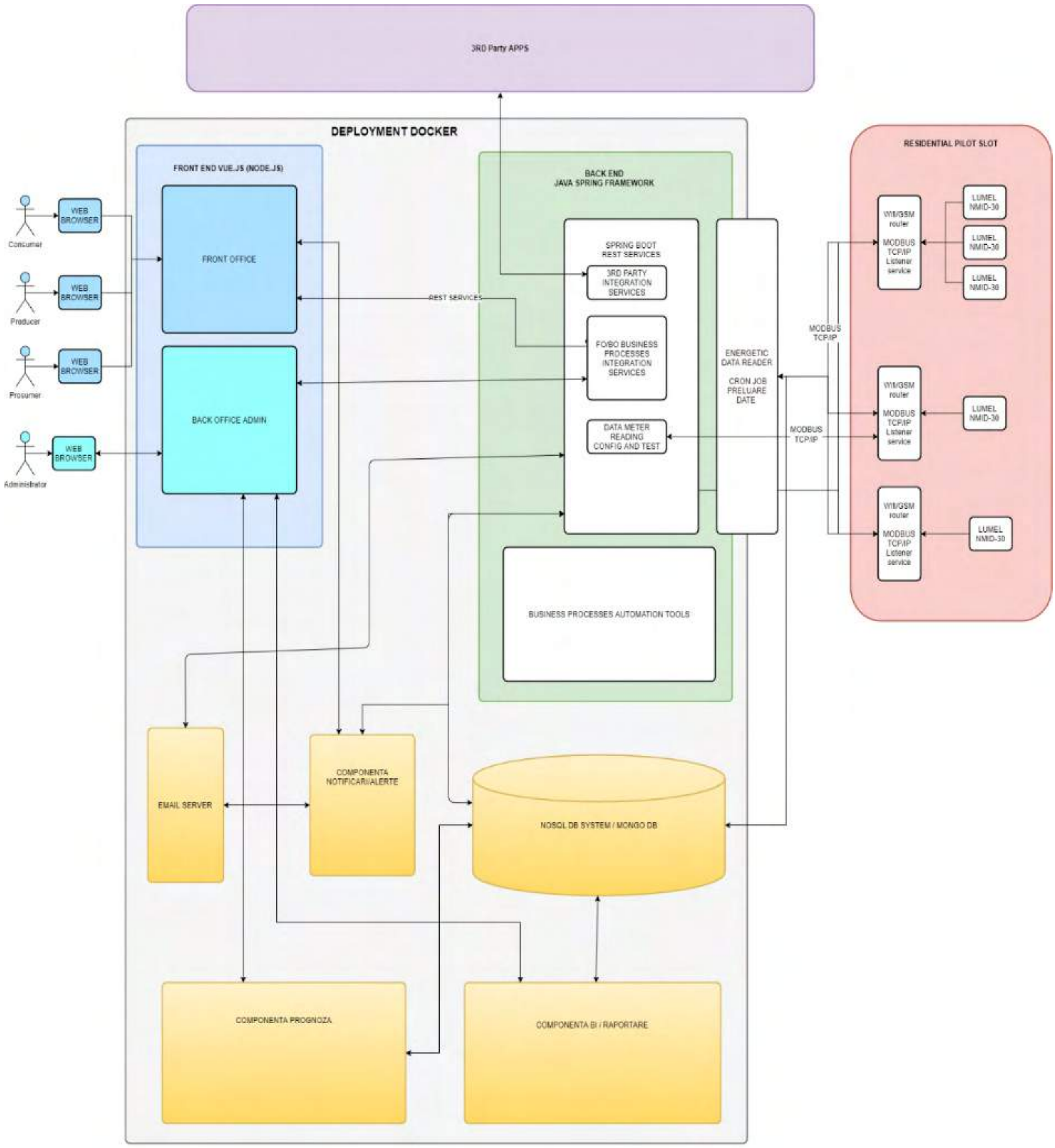
The following programming languages and frameworks are used to implement the application's functionalities:

- Vue 2.6.10 Framework and vuetify 2.2.11 CSS Framework;
- JavaScript;
- Java Spring Framework - Java 1.8;
- MongoDB: MongoDB Query Language (MQL)

At the time being, the development of the platform is running on this environment:

- OS Distributor ID: Ubuntu Description: Ubuntu 18.04.5 LTS Release: 18.04 Codename: bionic
- Web Server: Package: apache2 Version: 2.4.29-1ubuntu4.19
- Server version: Apache Tomcat/9.0.16 (Ubuntu) Server number: 9.0.16.0 JVM Version: 1.8.0_292-8u292-b10-0ubuntu1~18.04-b10 Package: mongodb Version: 1:3.6.3-0ubuntu1.4
- openjdk version "1.8.0_292" OpenJDK Runtime Environment (build 1.8.0_292-8u292-b10-0ubuntu1~18.04-b10)
- Hardware: 8XCPU Intel(R) Xeon(R) CPU E5-2650L v2 @ 1.70GHz, 150 GiB HDD, 32GB RAM

The platform architecture is summarized in the following diagram.



It comprises:

- Front-end module for data presentation and display;
- Back-end modules for data processing;
- Middleware layer for measuring device interface/ IoT / 3rd party API interface for market integration;
- Automation layer for the control and operation for the business processes and usage of the open-source technology;
- MongoDB Compass database for storing and processing consumption / calculation / historical data.

Within TEAP, the following level 0 processes have been identified, which are derived in more detail in subprocesses:
- TEAP registration;
- Associations;
- Energy data:
- Forecast;
- Markets:
- Orders;
- Transactions;
- Reports;
- TEAP Management.

Regarding the data privacy management, the reports are intrinsically "anonymized" in the application, at the platform level, each user can see her/his own reports. The reports seen at the platform level use a synthetic ID, e.g. of the user with whom the match was made on the transaction sale/buy in the DAM market.

Other mechanisms provided are TCs Terms & Conditions, the removal of personal data from the platform / database upon withdrawal from the platform / deletion of the user account, leaving only "traces" of the user's transactions for further analysis for audit purposes.

Also the distinction at the profile level(visitor, transactional user, administrator or strategic energy supplier) enjoys clearly separated and defined security privileges.

The platform coordinator (administrator) role within the platform is essential, firstly because she/he enables participants to become transactional users for example by approving their TEAP Coins purchase. Otherwise, the coordinator has no influence on the transactional energy market. Here the participants have three trading modes: manual, autopilot or a hybrid one where the participant can be in autopilot mode on the day ahead market but in manual mode on the intraday market. The transactions don't require the coordinators approval but they are secured by the one transaction mode. This means that on the transactional market (Dayahead, Intraday) within the opening hours and for a certain time slot there cand be only one transaction, that once placed can't be replicated/generated anymore.

The automatization level is actually decided by participants' profit motivation. That means that in auto trading mode the user only signs in, allocates his smart meter to his profile and lets the platform take care of his energy consumption/production. However because TEAP works with forecasts the participants' gains depend on its accuracy. On the long run the forecast will become more and more accurate and secure the participant profit but on short or medium term would be better for the user to engage manually on intraday to adjust her/his energy forecast or make better deals with peer-to-peer energy trade.

These trading possibilities conclude that the platform represents a mix between a centralized market and a peer-to-peer energy market and lets the participants the trading choice. However under the present development stage of the platform peer-to-peer trading requires more effort and attention from the user, and more understanding of the transactional logic. Thus at this moment it is realistic to estimate that most participants would opt for an auto-trading mode in a centralized market with smaller profits but less time consumption

5. The SOGUI framework: a guideline tool for social innovation initiation in the energy sector

This section gathers the main suggestions and formalises a useful framework (the SOGUI framework) for actors that are willing to launch a social innovation in the energy sector. The next subsection details the ownership models in the energy sector. Then the SOGUI framework is presented in detail, explaining how to use this guideline tool for social innovation initiation in the energy sector. In the Annex1 the framework is presented ready to be printed in order to be used for ideation sessions or diversification processes.

5.1. Ownership models in the energy sector

Community ownership is the core of the idea behind citizen and renewable energy communities. The energy community can own part or the entirety of an energy resource. The resources are usually generating units, but can also include storage units, electric vehicles and charging stations, or district heating and cooling grids. Most commonly, energy communities (EC) own the full installations, with companies, non-profits, or local governments owning shares within the energy community (IRENA, 2020). However, energy communities can own shares of projects, this is most common in projects that are too big for the EC to take on themselves, such as onshore wind parks.

The most common ownership models as described by IRENA (2020) are cooperatives, partnerships, non-profit organisations, community trusts, and housing associations.

Cooperatives are by far the most widely implemented model in the EU. The first community owned renewable energy installations mostly relied on cooperative structures and looked beyond profits, seeking to provide economic, social, and cultural benefits in the locality they operated in. It is thus no surprise that the EU definition of renewable and citizen energy communities was modelled after this structure. Crucially, cooperatives follow the democratic principle of one member one vote, regardless of the number of shares or equity that that member has in the cooperative. This means that no single member can have any outsized influence on the decision making of the cooperative. The governance and ownership structures of renewable (REC) and citizens (CEC) energy communities are defined in articles 22 of the REDII and 16 of the IEMD respectively.

Partnerships are rarely used in the EU context of RECs and CECs. Generally, partnerships have a clear profit maximising objective (IRENA, 2020), this would directly exclude them from the EU definition of a REC or a CEC. Partnerships can still include a variety of community stakeholders, including citizens, but do not follow a one member one vote system.

Non-profits can fund community energy projects. Their non-profit nature means all profits are reinvested in projects or used for the community in other ways. Community members can invest in the non-profit (or donate to it) and they will develop projects in the community on their behalf. The ownership, however, is not as direct as in a cooperative, and donating money to the non-profit does not necessarily give the citizen a vote in the governance structure of the organisation.

Community trusts or community interest companies legally ensure that the assets owned and profits generated are used for the benefit of the community and not for the benefit of the shareholders. As with non-profits and partnerships, the inclusion of citizens as members or shareholders with voting rights is not guaranteed.

5.2. The SOGUI framework

5.2.1. WHAT DOES IT FOR?

After a period of reflection on a specific topic related to energy (from production to consumption), initiatives and projects are created to face the problematics related to it. To facilitate and support the implementation of these energy-related projects, a methodology that will allow to define the framework of the project has been developed. This will help to anticipate the organization of the different activities to be undertaken and the definition of different stakeholders depending on the needed skills and used technologies.

5.2.2. HOW IS IT BUILT?

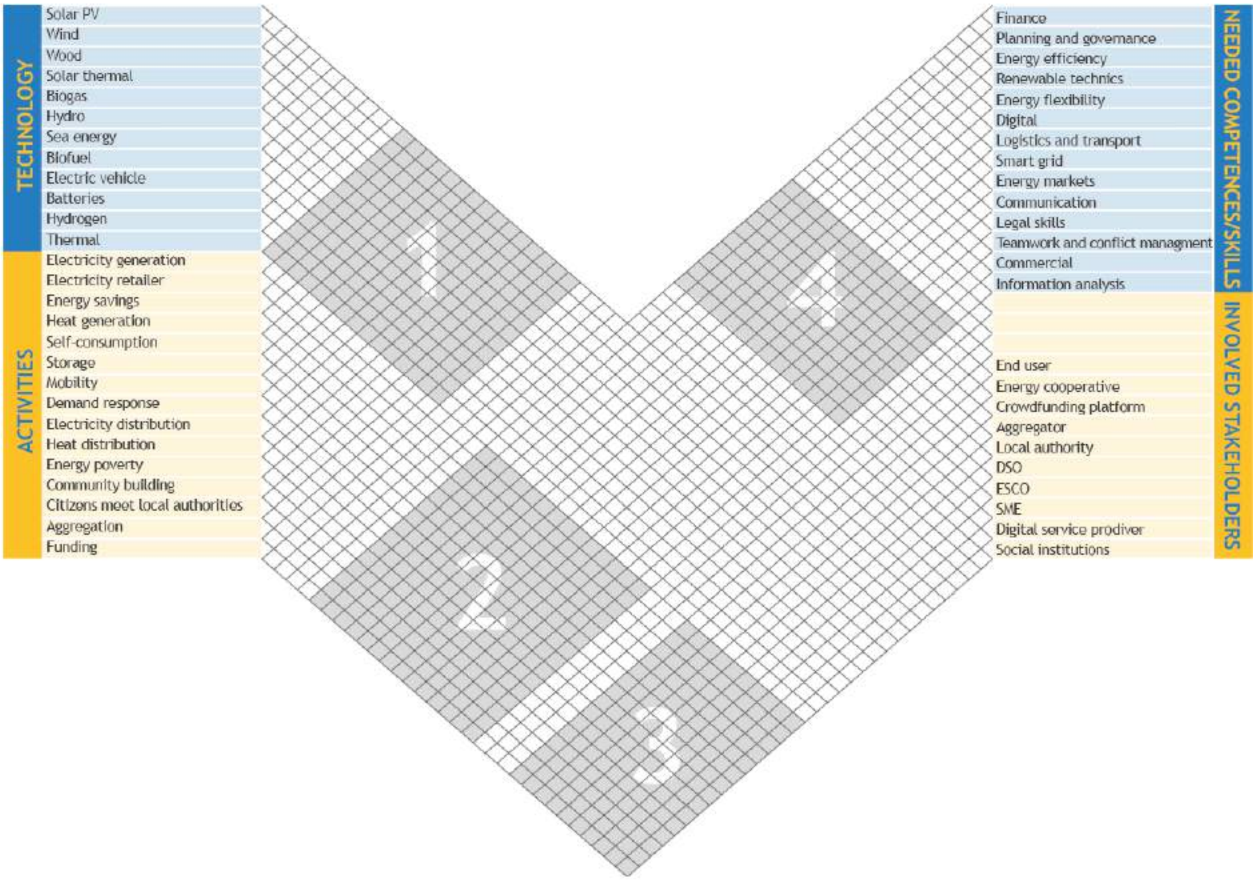


Figure 1. The tool of the methodology

The methodology is divided in 4 parts:

- The technologies that can be used for each activity in the energy field are proposed : solar PV, wind, wood, solar thermal, biogas, hydro, sea energy, biofuel, electric vehicle; batteries, hydrogen and thermal.
- Different activities in the energy field are listed, to choose the ones that will be used to develop the defined project: electricity generation, electricity retailers, energy savings, heat generation, self-consumption, storage, mobility, demand response, electricity distribution, heat distribution, energy poverty, community building, citizens meet local authorities, aggregation and funding.
- The needed competences/skills to accomplish these activities are also proposed: finance, planning and governance, energy efficiency, renewable technics, energy flexibility, digital, logistics and transport, smart grid, energy markets, communication, legal skills, teamwork and conflict management, commercial and information analysis.
- Potential stakeholders for the different activities are given: end user, energy cooperative, crowdfunding platform, aggregator, local authority, DSO, ESCO, SME; digital service provider, social instructions.

Those 4 parts are cross-referenced according to 4 criteria:

- Technical synergies (T), defines the specific technologies used for each activity of the project.

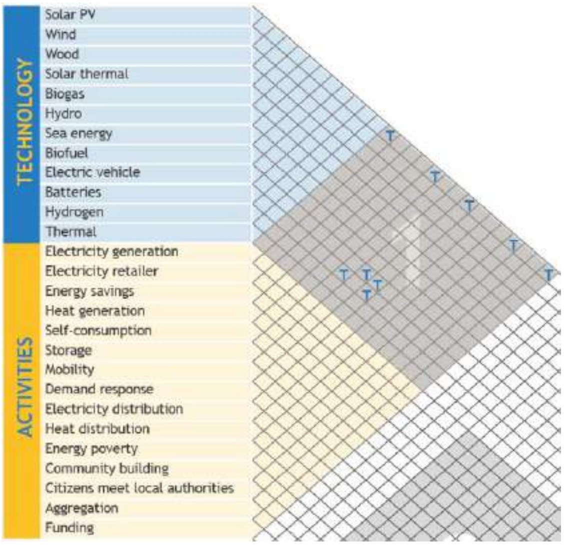


Figure 2. Graphic representation of Technical synergies

- Internal competences/skills (C), define which are the needed competences that shold be kept internally for each activity.

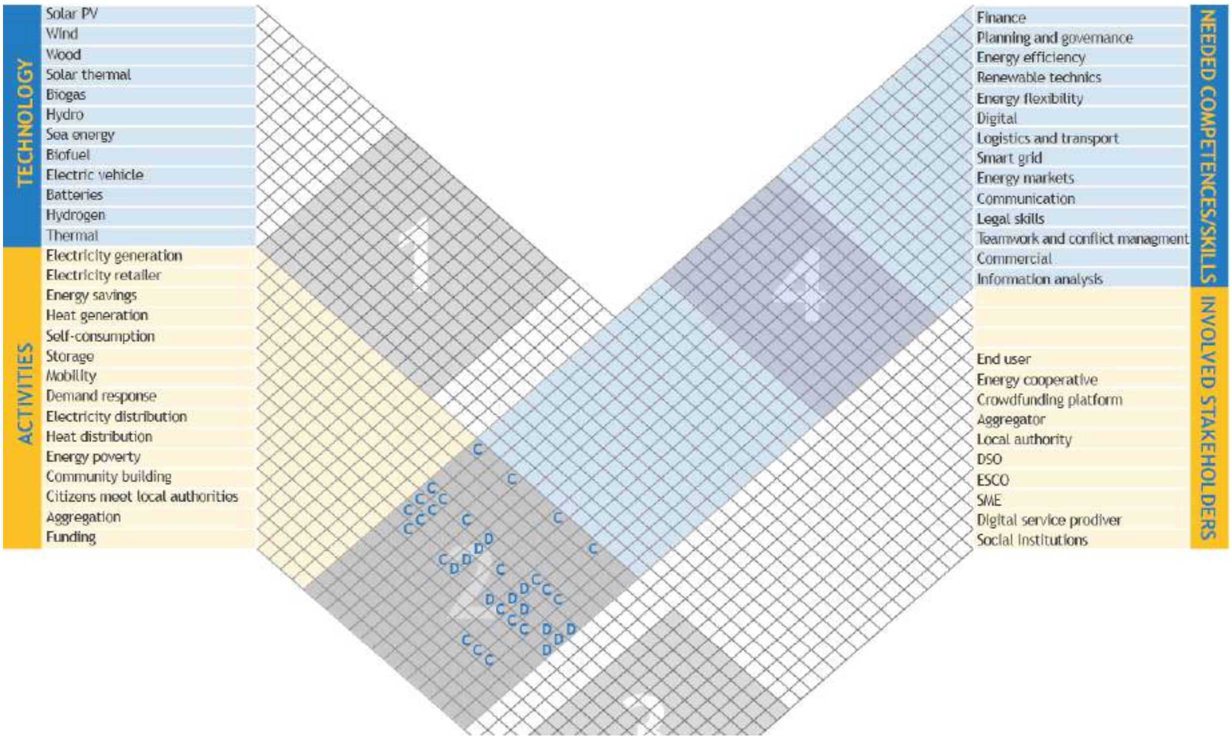


Figure 3. Graphic representation of internal competences and delegating competences

- Involved stakeholders (S), defines the involved stakeholder for each activity.

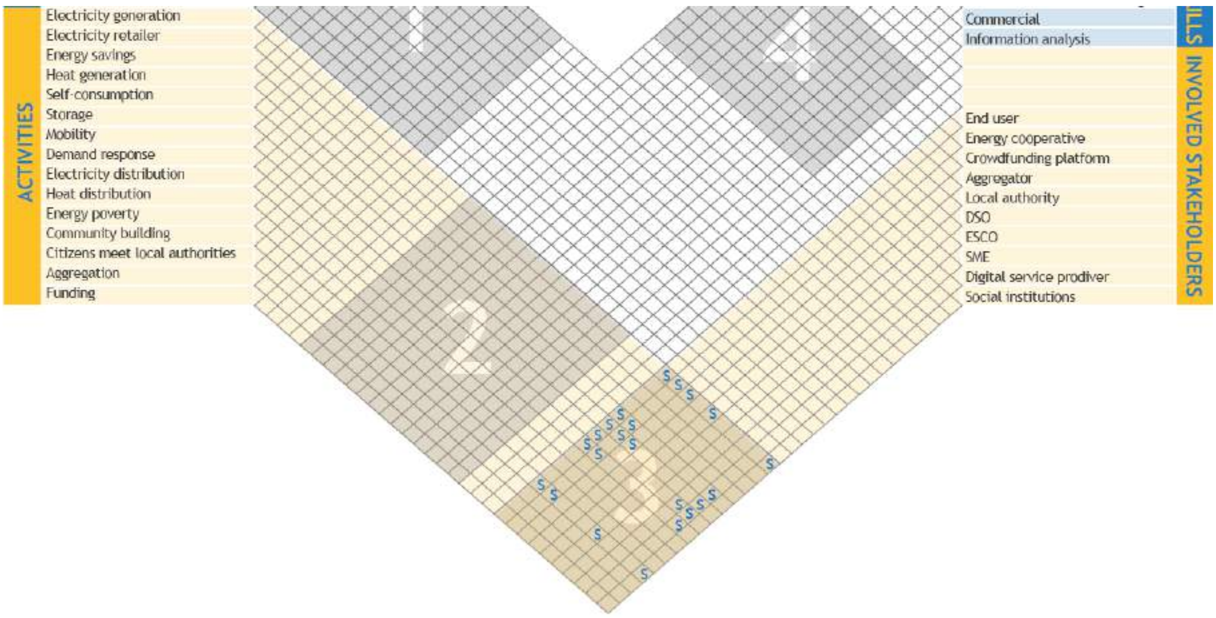


Figure 4. Graphic representation of involved stakeholders

- Delegating competences (D): It defines which are the needed competences that are planning to be subcontracted.

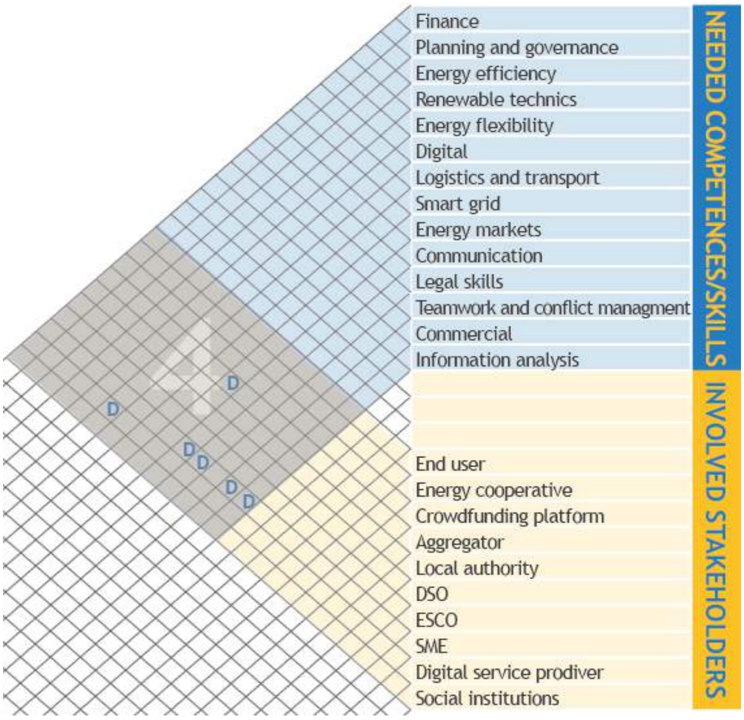


Figure 5. Graphic representation of delegating competences

5.2.3. HOW DOES IT WORK?

This methodology is used in 4 steps that will help to define framework of the project.

1st step:

→ In the first step we are **looking technical synergies between activities and technologies** that are applied.

In this example, the project consists on installing solar PV in a community building in order to promote self-consumption. The optimization of the self-consumption will be achieved by demand response activities, adding a storage system based on batteries. Moreover, the system will allow charging the electric vehicles.

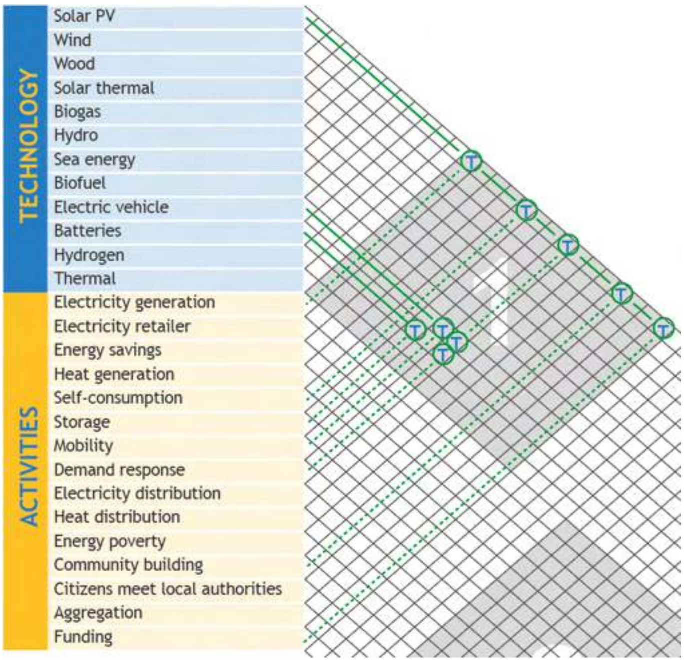


Figure 6. Example for the 1st step

2nd step:

→ The second step is to **identify the competences we need internally** in the energy community. There are two choices:

- C, if we want to keep the **competences internally**
- D, if these competences are **subcontracted.**

In the case of mobility, finance, planning and governance will be managed internally. However, a car sharing system will be developed by a subcontractor in order to manage the required skills for the implementation of the service: digital, communication, legal skills, commercial and information analysis.

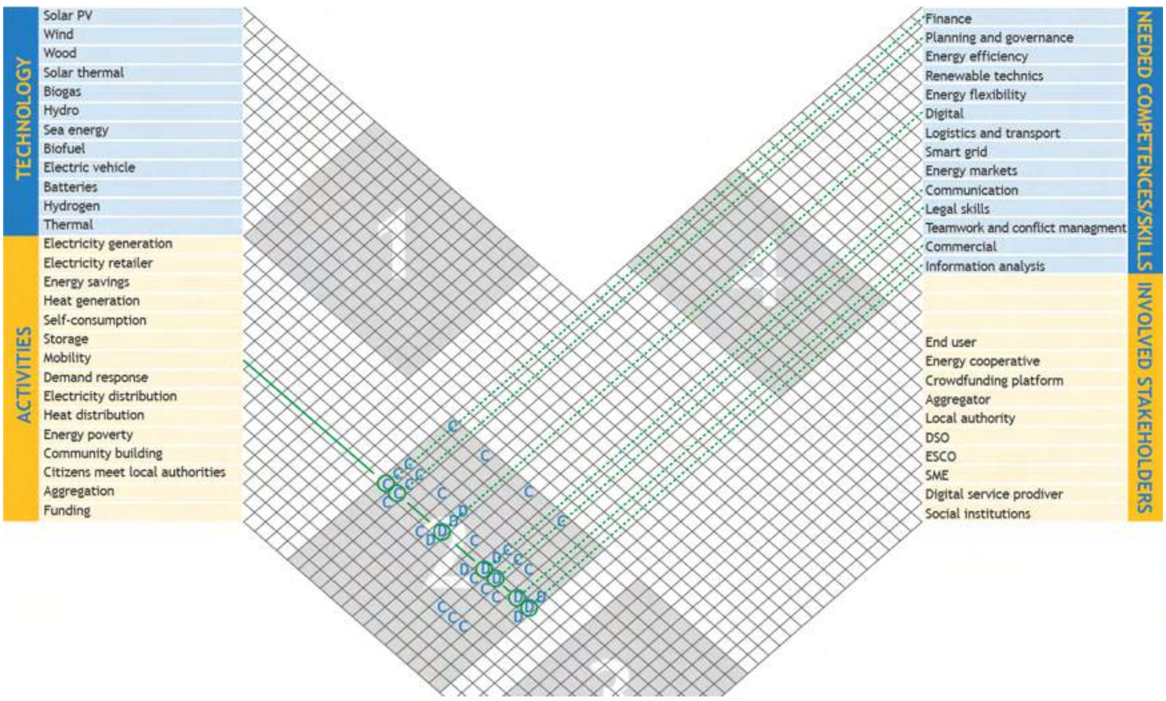


Figure 7. Example for the 2nd step (1/2)

It is also planned to check if demand response activities allow the project to participate in energy markets. In this case, the task will be subcontracted to an aggregator, but this part is identified in step 4.

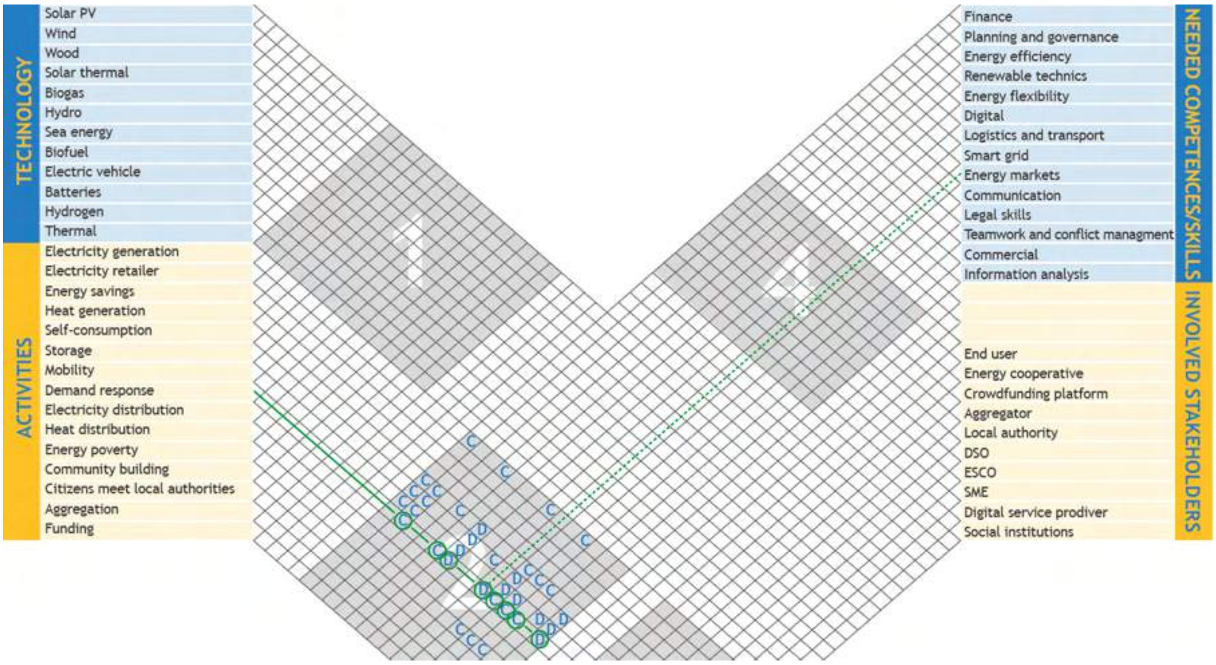


Figure 8. Example for the second step (2/2)

3rd step:

In the 3[rd] part, the **involved stakeholders are defined for each activity.**
In this case we are planning to fund the battery system with a crowdfunding platform.

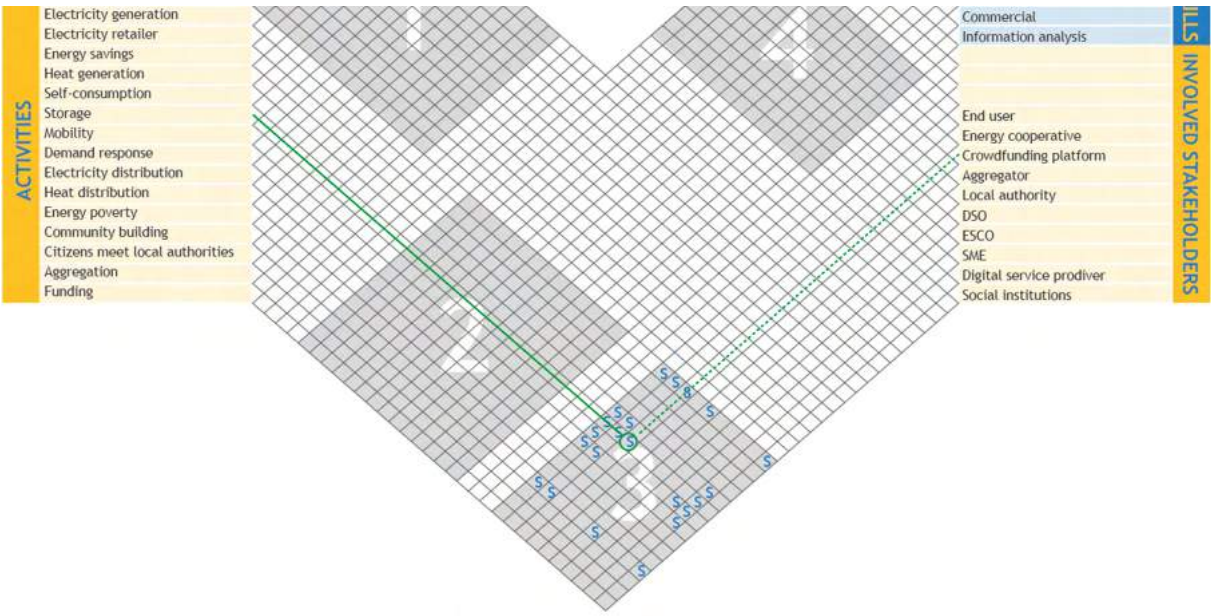


Figure 9. Example for the 3rd step (1/2)

In this case the community building is managed by the city council and we will work with local authorities to install solar PV. Social institutions will also manage the installations of solar PV and community building.

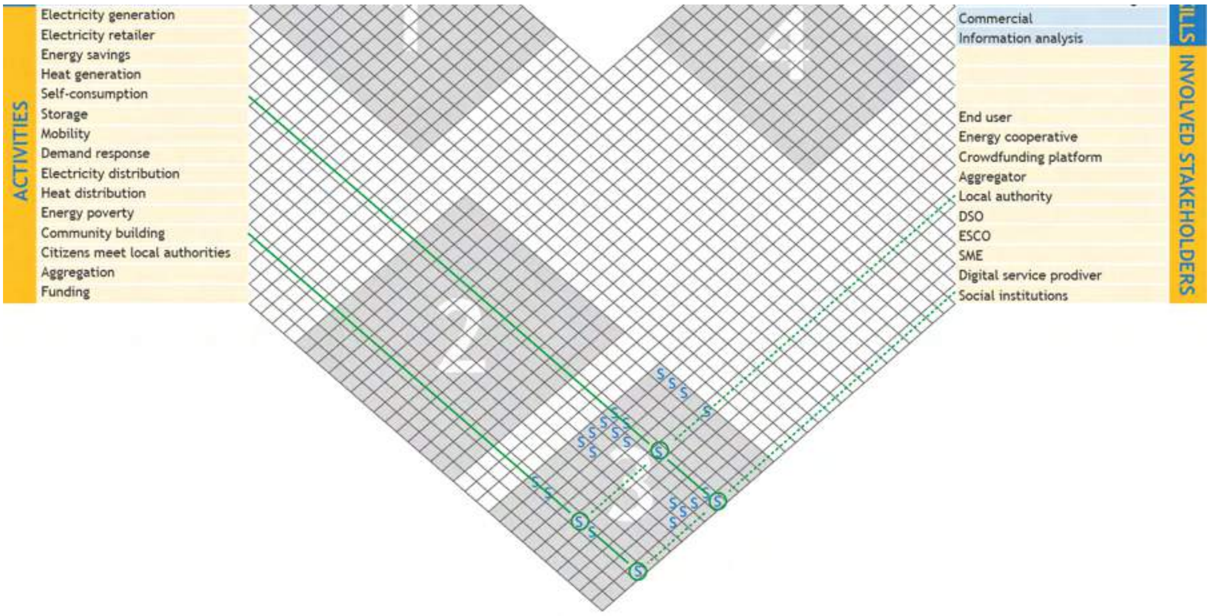


Figure 10. Example for the 3rd step (2/2)

4th step:

The 4th step defines the **delegating competences for those activities** that have been defined as **subcontracted** in the 2nd step.
For example, in the case of mobility, it will be managed by a SME for communication, legal skills and commercial. Digital skill will be managed by a Digital service provider.

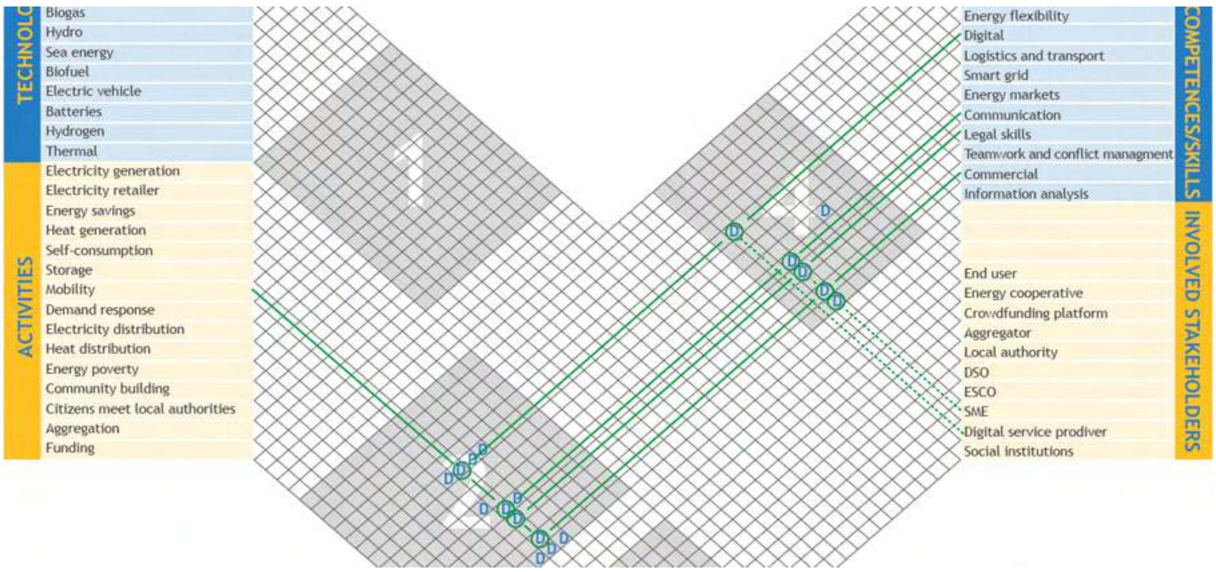


Figure 11. Example for the 4th step

All those steps will permit to define the framework of the project and will help the different initiatives/associations/companies to define the framework of their social innovation project in the energy field.

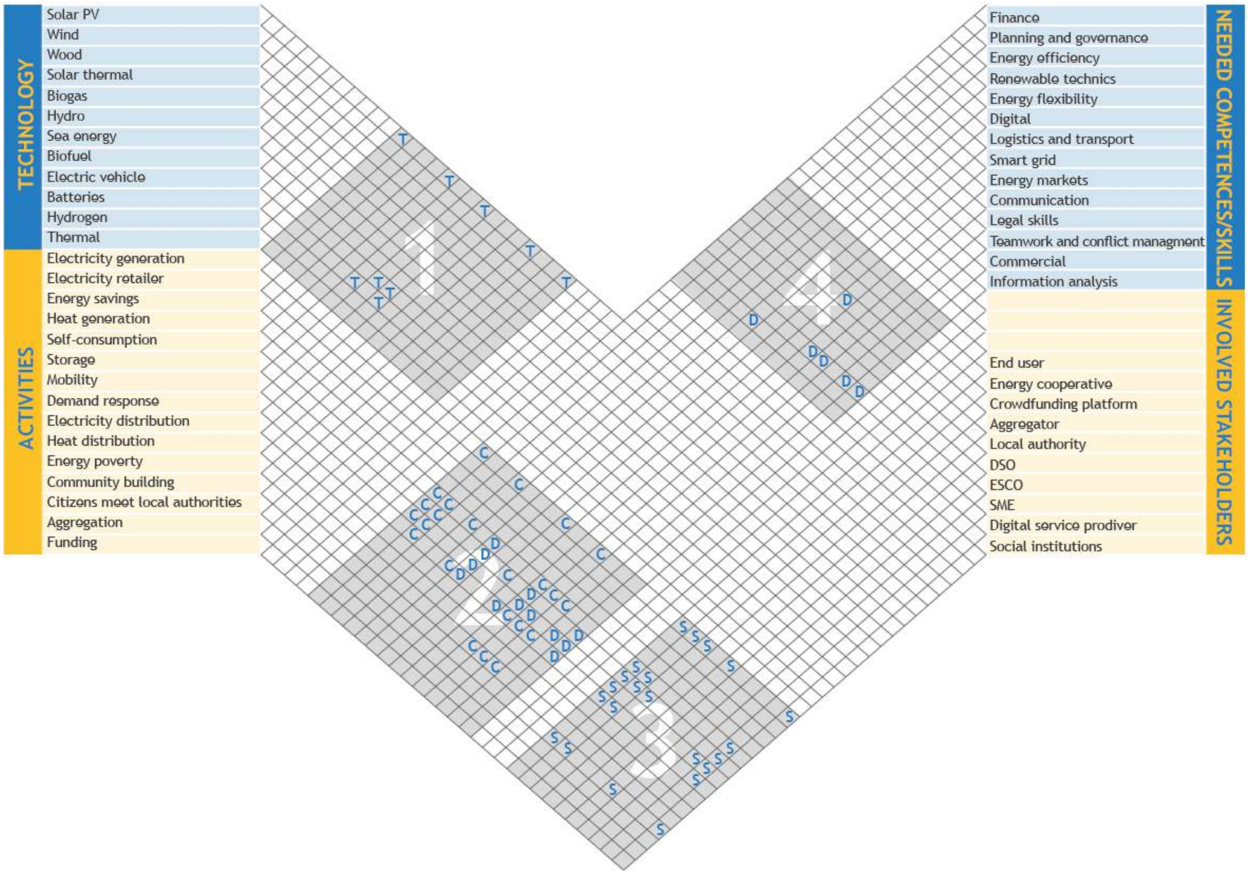


Figure 12. The tool of the methodology applied to a project

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Annexe 1: The SOGUI framework

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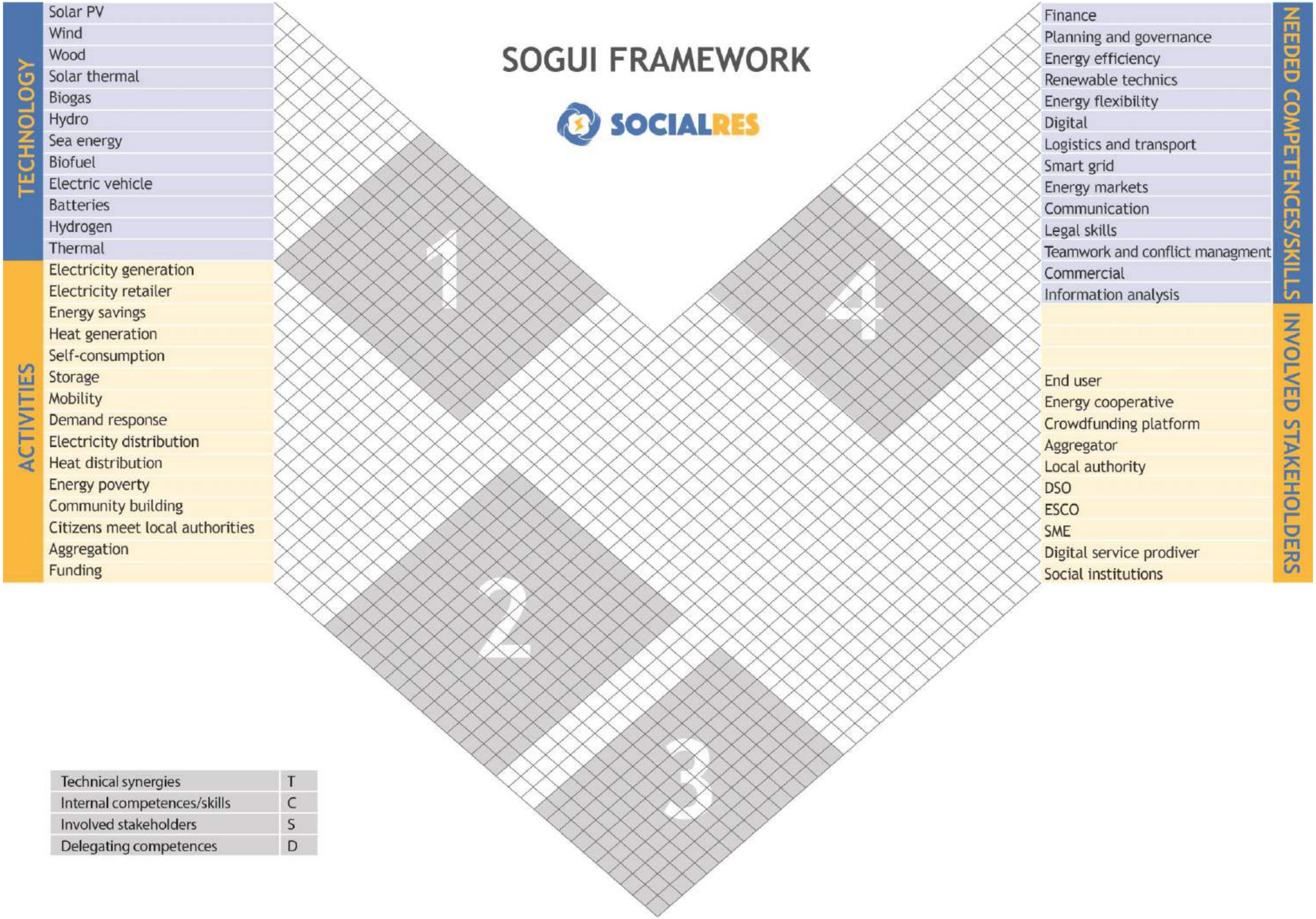
SOGUI FRAMEWORK

SOCIALRES



Technical synergies	T
Internal competences/skills	C
Involved stakeholders	S
Delegating competences	D

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