# Quadruple Helix Stakeholders and Social Innovation in the Energy Transition

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*Abstract*

*Social innovation (SI) aims at improving people's life when technological or business innovations are not sufficient. However, the classic Triple Helix (TH) theory does not explicitly deal with SI, and relegates civil society to a passive role. This paper aims to analyze if SI requires an evolution of the TH framework. The methodology is a multi-case study based on SI projects and initiatives in the energy sector.*

*The main findings are that citizens are involved in SI though to various extents: there are SI projects carried out "for" citizens, "with" citizens, and to a much lesser extent; "by" citizens. SI in the energy sector rely also on the commitment of the local government and the presence of social enterprises. Therefore, we suggest that a Quadruple Helix (QH) approach may be necessary for energy-related SI.*

**Keywords:** Social Innovation; Energy Transition; Triple/Quadruple Helix; Civil Society; Citizens' Participation; Global Markets

## 1. The Challenge

The climate crisis requires innovative approaches that rely on the active engagement of a plurality of stakeholders including companies, institutions and civil society (Civera & Freeman, 2020; Risso, 2012). Scholars and policy makers are showing increasing interest in social innovation as one of the enablers of the energy transition (Hoppe & DeVries, 2019; Wittmayer et al, 2020). Social innovation (SI) concerns responses to unsolved or inadequately met social problems and needs that have been unsuccessfully addressed by the market (Pol & Ville, 2009) and are

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increasingly recognized as important to respond to the grand challenges of our time (Benneworth & Cunha, 2015). By addressing the social dimension of energy transition, SI can enable changes in social practices and/or social relations (Sovacool et al., 2023).

SI is a particular type of innovation. The Triple Helix (TH) theory states that innovation can be spurred when business, government, and academia work together. TH posits that industry is the locus of production, whereas the government issues legislation that guarantees stability, and the university develops new knowledge (Etzkowitz & De Mello, 2003). This model has been very influential and many policymakers have drawn inspiration from it, often for local and regional development policies (Rodrigues & Melo, 2012). The TH scholars have given little attention to SI possibly because of the techno-economic paradigm dominance in this field (Cinar & Benneworth, 2021).

Addressing societal challenges requires the collaboration of higher education institutions (HEI), government, businesses, and organizations representing citizens, therefore a Quadruple Helix (QH) model has been proposed (Goddard, 2021). The fourth helix represents demand-side perspectives and is frequently associated with civil society (Roman et al., 2020).

In this paper, we analyze cases of SI in the energy sector applying the QH model to characterize these innovations and pinpoint their critical aspects. We do that by describing and discussing six examples of SI in energy carried out in the city of Grenoble, France.

This paper contributes to the emerging literature on SI in energy. Our cases suggest that SI strongly relies on the active involvement of local governments, and often depends on the participation of social enterprises. Moreover, these initiatives rarely involve universities and in most cases relegate citizens to a passive role.

In the next session, we will discuss the concept of SI. Then we will introduce the TH and QH models. We will focus on citizens and civil society both as a new helix and in SI. We will then clarify the research questions and methodological approach. We will introduce and discuss six projects/initiatives related to SI in the energy sector, showing the variety and extent of citizens' and other stakeholders' participation. We then discuss what are the main characteristics of SI in energy and highly some of their liabilities and conclude with implications for policymakers.

## 2. Social Innovation

Different from business innovation, carried out by firms seeking profit, SI aims to satisfy neglected human needs, thanks to collective action and tighter social relations, with a broader goal of socio-political transformation (Galego et al., 2022). Social innovation has been defined as "a collective process of learning involving the distinctive participation of civil society actors aimed to solve a societal need through practices that produce change in social relationships, systems and structures" (Edwards-Schachter & Wallace, 2017, p. 73). According to Benneworth & Cunha (2015), a SI develops innovative solutions across learning communities, it promotes

community development and collaborative networks challenging existing social institutions. SI encompasses two 'core conceptual elements' related to process and scope: a change in social relationships, systems, or structures, where this change satisfies a human need or addresses socially relevant problems (van der Have & Rubalcaba, 2016). Social innovations are very often new services with the following distinctive features: they do not pursue profit as the main goal, they aim at empowering citizens, and they involve actors that are not typically associated with innovation, such as NGOs, social entrepreneurs and activists (Schartinger et al., 2023).

No wonder SI is fashionable and popular. Institutions such as the European Commission have endorsed it as a panacea for societal problems: "Social innovations are new ideas that meet social needs, create social relationships and form new collaborations. These innovations can be products, services or models addressing unmet needs more effectively."[1] SI has a positive connotation because it evocates improvement over a previous condition, therefore it has great consensus. SI is a sort of "magic concept" (Bragaglia, 2021).

To support the SI process, stakeholder relationships are necessary for organizations to overcome constraints, access resources and deploy capabilities (Phillips et al., 2019). Citizens, whether activists or not, may drive these processes, though Non-profit institutions have often this mission. Universities can also contribute to SI in many ways: as providers of existing knowledge, or developers or co-creators of new knowledge useful to develop a new solution. Van der Have & Rubalcaba (2016) argue that SI is fostered by experimentation carried out by business and service actors as well as social movements. Universities can also be advisers, they can leverage on their network of experts and also provide visibility and legitimacy to social innovators.

In sectors such as energy, where technological innovation is carried out by firms, universities and research labs, SI involves non-technological innovations, as new purchase and usage behaviors, or their active involvement in research, practice and policy (Wittmayer et al., 2020). SI enables the considerations of long neglected social dimensions behind the energy transition (Hirsh and Jones, 2014). Scholars have for instance highlighted that SI in energy can contribute to increase social acceptance of energy infrastructure (Maruyama et al, 2007), increase energy justice (Hiteva and Sovacool, 2017 and empower consumers (Hewitt et al, 2019).

## 3. The Triple Helix Model and its Evolution

The TH idea was originally conceived to explain the development of a high-tech region such as Boston's Route 128. It was observed that knowledge-based economic development requires that industry creates value, the university creates knowledge, and government supports innovation directly and indirectly (Almeida et al., 2012).

These three helices influence each other and evolve over time, though three ideal types have been identified: laissez-faire Triple Helix regimes where industry is the driving force, statist Triple Helix where government is the core spiral, otherwise entrepreneurial university leads this interplay (Etzkowitz, 2003).

Carayannis and Campbell (2010) propose a fourth helix that they call "media-based and culture-based public" arguing that people's culture and values and media reality construction influence the innovation process. It has been argued that the civil society is too important to be considered a helix in itself, and that it is rather the context where the three helices interplay and the beneficiary of them (Cai & Etzkowitz, 2020). However, the TH model does not explain the relationship between citizens and the helices, focusing mainly on high-tech and large companies (Nordberg, 2015). Moreover, civil society can inspire business ideas and be a driver and supporter of entrepreneurial initiatives (Amaral, 2015). End-users can be knowledgeable and active innovation players, therefore they can be also identified as the Fourth Helix (Del Vecchio et al., 2017).

To overcome the limitations of the TH model, Etzkowitz & Zhou (2006) posit that two TH systems exist: the institutional university-industry-government system where the spheres interact to achieve technological innovation and a TH twin composed by the public, university and government, where the public, mostly represented by activist citizens (non-governmental organizations and individuals), replaces the business and engages in controversial issues on technological innovation such as Genetically Modified Organisms or Nuclear Energy.

This is further advocated by Zhou & Etzkowitz (2021), who identify two kinds of development: innovative and sustainable, and they are fostered respectively by the University-Industry-Government and the University-Public-Government twins. However, it is difficult to believe that economic interests will not try to influence key societal debates, and that business can actually be excluded from issues of considerable economic value.

Moreover, excluding the industry from the governance of sustainable development may not be the most effective way to attain it. The same scholars acknowledge that the TH model can be insufficient, and suggest using the most relevant TH twin rather than adding further helices. Such an approach could be interpreted as a QH in which only three helices are interacting at the same time. The four helices Academia, Civil society, Business, and Government would interplay as different triplets of helices according to the specific innovation dynamics. Therefore, even in a QH model, only three helices may do the work (Leydesdorff & Lawton Smith, 2022).

Triple and Quadruple Helices are competing concepts, though they may be related by an evolutionary process and eventually, they can supplement each other (Cai & Lattu, 2021).

Despite the lack of consensus regarding what the fourth helix contains (Höglund & Linton, 2018), the European Union has adopted the QH model as the theoretical framework to underpin its regional innovation policy, with the aim of creating a sustainable and inclusive growth in Europe.

## 4. Civil Society and Other Helices' Contribution to Innovation

Nordberg et al. (2020) believe that local citizens should decide which innovations to implement and the TH spheres should support them in their innovation needs and goals. This is particularly true for SI, as its purpose is to create social value and foster

more inclusive relationships. Because of its heterogeneity and fragmentation, it is difficult to identify the boundaries of civil society and who represents it.

Often citizens are actively engaged in voluntary and no-profit activities. The SI system should rely both on a knowledge and democratic logic, implying the engagement of third-sector organizations as well as active citizens and social entrepreneurs (Carayannis et al., 2021).

However, it is not easy to enact citizens' participation. Often, there are obstacles such as contextual factors, such as their level of information, organizational arrangements, such as how to select community representatives and how to structure the participation process, and group dynamics (Ianniello et al., 2019).

Analyzing the role of citizens in Living Labs, Del Vecchio et al. (2017) found that often they are just end-users, while in other cases they test the product/services developed, but very seldom they lead this development. In other words, most innovations are done "for" the citizens, while in a minority of cases they are "with" the citizens, and almost never "by" the citizens.

Though high levels of citizens' participation are quite rare (Bally & Coletti, 2023), they signal a gradual shift from "government" as the institutional decision-making body, to "governance" where the decision process is shared (Nijkamp et al., 2023). Civil servants and citizens should work in concert to overcome the traditional separation between these spheres (Morgan, 2021). As in other forms of innovation, collaboration matters, therefore finding the most adequate governing form is crucial (Coletti & Landoni, 2018).

In the classic TH model, civil society is considered a passive recipient of TH interactions (Cai & Etzkowitz, 2020). Limiting the role of society to beneficiary of the TH innovation system may overlook key actors and lead to a top-down vision of innovation. Innovations should be beneficial to citizens and end users (Höglund & Linton (2018). Citizens can contribute to re-design policies. Re-imagining their role as subjects rather than objects of the state, they will regain trust in public institutions (Morgan, 2021).

Collaboration is intrinsic to the Hybrid Autonomous Organizations (HAOs). According to Champenois & Etzkowitz (2018), HAOs are institutions designed to promote innovation through the integration and combination of elements from the TH spheres. Connecting different actors, these organizations can act as catalysts for innovation and they are often not controlled by one specific helix (Hasche et al., 2019).

HAOs, communities, and partnership platforms are spaces of decision which can be drivers of SI, acting as brokers or interfaces between government and citizens (Nijkamp et al., 2023).

Discussing energy projects, Beauchampet & Walsh (2021) found that to increase social engagement and acceptance actions such as iterative dialogue between relevant stakeholders and local citizens should be established, with timely communication, real consultation, and increased control.

However, when there are marginalized citizens, their lack of resources might hamper community power and undermine their goals. In such cases, capacity building becomes necessary, i.e. programs to improve the skills, knowledge, and technical abilities of residents (Rosen & Painter, 2019). Nonetheless, the civil society's fragmentation and heterogeneity limit the possibility of engaging it in participatory processes through uniform interactions (Roman et al., 2020).

Concerning the contribution of academia to the governance of innovation, Hasche et al. (2019) warn that universities are not easily involved in QH collaboration because their prioritize publications, research grants, and teaching.

Zhou & Etzkowitz (2021) assume that private firms can no longer overlook their social and environmental impact. This can be taken for granted only for social enterprises (SE), i.e. those with societal and environmental goals beside profit (Olofsson et al., 2018),

It is unclear how the subjects involved in QH interact, make decisions, and cooperate, especially at the micro level, though most SI cases show a common nexus, such as a basic layer of reciprocal understanding, upon which a shared vision can be developed and joint action decided (Bellandi et al., 2021).

The analysis of the extant literature shows that the TH in the original formulation is ill-suited to the evolution of a society in which citizens should be involved to address societal challenges. Social innovation requires the participation of individuals and organizations not comprised in the TH spheres, but which may be included in a fourth helix. This piece of research aims at contributing to academic debate on who should be involved, and how this may happen.

## 5. Research Question and Methodology

The emerging innovation system enlarges the participants' pool and considers new roles for traditional players. SI, whether to address Grand Challenges or smaller social issues, should rely on a more inclusive framework than the original TH. According to Kulhmann & Rip (2018), this can be achieved with more public-private partnerships, the involvement of charitable foundations, as well as establishing intermediary organizations and spaces for interactions to enable and improve concerted action. The objective is to build a system that is human-centered, sustainable, and resilient (Fortuna & Paesano, 2022).

Our aim is to use the QH framework to describe and characterize cases of SI in energy. If and how QH stakeholders contribute to social innovation in energy is our research question

The answers to this question will help policymakers and engaged stakeholders to set the stage for the success of SI projects. Whereas, the academic contribution will be mainly to the TH/QH literature, which is very scant on two aspects: how the spheres interact with each other to foster SI and how civil society can be a proactive actor in this process. On the other hand, the ecosystem for SI has been relatively little studied, and it is time to address this literature gap (Cinar & Benneworth, 2021).

To answer these questions, six initiatives related to the energy sector will be presented. Despite its social and environmental relevance, the energy sector is a challenging place for SI because of its inherent centralization, which is due to capital intensity, technological sophistication and regulatory complexity (Hewitt et al., 2019). These cases are all located in Grenoble, a middle-size city in the South-East of France with a strong tradition in energy innovation.

### 5.1 The Context: SI in the Energy Sector

Power (electricity + heat generation) is the biggest contributing sector to Green House Gas Emissions (Rissmann et al., 2020). This is reflected in three of the 17 United Nations Sustainable Development Goals (SDGs): 7. Affordable and clean energy, 11. Sustainable cities and communities, and 13. Climate action (European University Association, 2017).

Historically, the transition towards cleaner forms of energy production and use was deemed possible only through new or improved energy technologies, developed either through public or private research (Sagar and van der Zwaan, 2006). Moreover, because the energy sector is heavily regulated, the role of government and public bodies in issuing policies and regulations is fundamental to managing the sector and steering its evolution. Technology is just one of the factors leading to the achievement of SDGs and given the number of technological options available at any given moment, it can lead to controversial decisions (Byskov et al., 2020). Other players such as private firms, renewable energy associations, and environmental NGOs influence and shape energy policies too.

However, the adoption of cleaner sources of energy is not enough to reach the SDGs. Saving energy through reduced demand and increased energy efficiency is also necessary. Centralized fossil fuel systems should be replaced by decentralized renewable energy. To get there, both the supply and demand sides of energy markets need to change radically. Besides technological innovation, there are new ways of organizing and governing energy systems. These are forms of SI aiming at the transition towards a zero or low-carbon energy system, but also social goals such as community empowerment and energy justice (Hoppe & de Vries, 2018).

At the level of individual users, SI can be useful to tackle energy poverty and the broader issue of energy justice. Energy poverty is strictly related to the availability and affordability of fuels, whereas energy justice also implies transparent information and participatory governance, to allow the involvement of users and citizens in the decision-making process (Hiteva & Sovacool, 2017).

However, civil society-led energy projects can achieve little without policy support, and a favorable ecosystem of interdependent organizations to enable these projects is key to the emergence of a more sustainable energy system (Vernay & Sebi, 2020).

In the next section, we will explain the reasons for analyzing SIs related to the energy sector happening in Grenoble and its metropolitan area.

### 5.2 Energy in Grenoble

Grenoble has a long tradition in energy and innovation. In 1925, an event to celebrate the hydroelectric power was hosted there: “l’Exposition Internationale Houille Blanche et Tourisme“ was also an occasion to brand the city as the capital of the French Alps, and indeed mountains are a favorable environment for hydroelectricity.[2]

In 1958, the Centre d'études nucléaires (Nuclear Studies Center) de Grenoble was established, and in 2018, the first unit to produce green hydrogen in France was built.[3] The KIC Innoenergy (Knowledge Innovation Community, part of the

European Institute of Technology) France is based in Grenoble. Grenoble is also the headquarters of the energy cluster Tennerdis and the energy equipment multinational corporation Schneider Electric.

From the sociopolitical perspective, it is worth noting that since 1983, environmental activists participated in the municipal elections, and in 2014, Grenoble became the first major French city to elect a Green Party mayor.[4] In October 2020, thanks to ambitious reforms and projects such as the participative budget, that allows citizens to allocate a portion of the municipal budget to grassroots initiatives often related to SI, Grenoble was elected the EU Green Capital 2022. Moreover, the city was awarded the prestigious Cit'ergie (European Energy Award) GOLD label.

The two key public actors in the energy domain are the Municipality of Grenoble, and the Grenoble-Alpes Métropole (GAM), an intercommunal entity of 49 municipalities of which Grenoble is the most important. Established in 2015, GAM is in charge of economic, social and cultural development, social housing, environment and energy transition.[5]

In this territory there are HAOs such as the Agence Locale pour l'Energie et le Climat (ALEC). Founded in 1998 as an association under the impulse of GAM, its mission was to contribute to the local energy transition through participation in the definition and implementation of public policies, the support of innovative actions and relevant partnerships, and technical assistance and advocacy.[6] The statute of association allowed the active presence of citizens. In 2020, the ALEC split into two parties: a public entity participated by GAM and other local public administrations, with the role of implementing energy policies and projects, and an association dealing mainly with information and training activities. The ALEC may be considered a QH hybrid autonomous organization. Indeed, citizens were actively involved throughout its history.

Among the social entreprises in the energy sector, the most relevant is GEG, the local gas and electricity utility heavily engaged in the energy transition.

From the methodological point of view, Grenoble can be considered an extreme case, and while this limits its representativeness on one hand, on the other hand, it makes insights more transparent and particularly interesting for Grand Challenges such as the energy transition (Eisenhardt et al., 2016). Grenoble may thus be seen as a living lab for the energy transition (Nijkamp et al., 2023).

### 5.3 Methodological Approach

Our research question can be effectively addressed with a case-study methodology. Such a qualitative approach helps to analyze complex phenomena such as the interplay of the spheres in the TH/QH models. Moreover, it may reveal information difficult to highlight with a less qualitative method, such as surveys. Moreover, case studies are useful to investigate the environment where organizations act (Yin, 2013).

Case studies are the best research approach to answer the 'how' and 'why' in contemporary events, and help understand how certain dynamics evolve over time (Bryman, 2008).

Multiple case studies include two or more observations of the same phenomenon and this enables both replications, that is the independent confirmation of constructs

or propositions, and, relevant to this piece of research, extension, when the cases reveal complementary aspects of the phenomenon (Santos & Eisenhardt, 2011).

Multiple case studies offer a robust framework for data collection. Theory emerging from multiple-case research is usually better grounded and easier to generalize than findings from single-case studies (Miles & Huberman, 1994).

Case studies are particularly suited to governance-related research as it is the study of power management and decision-making processes in collective context, and can be generalized to theoretical propositions. Multiple case studies reduce the risk of selection bias. Here, they will be used as explanatory cases. One of the main approaches to the application of this framework is to use extant theory to select variables useful to compare the cases (Stewart, 2012).

In the framework of the Horizon 2020 SONNET project,[7] ten interviews with public and private energy stakeholders have been carried out in 2020-21 mostly by one of our authors. The interviewees were asked to identify the most relevant local SI initiatives in the energy sector. Some of the respondents were involved in several of our case studies, so there are at least two interviews for each case. The objective was to identify which new combinations of ideas, objects or actions influence social relationships and involve innovative ways of doing, thinking and organizing the use of energy.

A semi-structured questionnaire was used and the interviews, carried out in French, were recorded (video and audio). The list of questions is in Annex 1. For each interview, the key points have been highlighted and translated into English. The list of the interviewees is in Annex 2.

In addition, secondary data were found in project reports and documents related to the case projects. These elements completed and clarified the collected pieces of information enhancing the validity of research findings (Yin, 2013). Six cases have been selected and will be described concisely later.

The cases are neither ideal types nor exhaustive of what SI in the energy sector can be about, however, they are all relevant examples of collaboration between actors from different helices. They are discussed with an explanation building technique, a special type of pattern matching which for multiple-case studies aims at creating an overall explanation of the phenomenon at hand. Explanation building is gradual and may be subject to rival explanations (Yin, 2013). We assume that our interpretation is consistent with the reality in the field and helps shape a theoretical model that can be useful to other scholars and policy-makers.

## 6. Findings

All six cases correspond to an innovative energy project carried out in Grenoble. For each of them, we describe the scope, year of start, the main stakeholders and we include a table with their typology according to the QH framework. In the Government column, local public administrations and entities completely controlled by them are listed. In the Business column, we kept the firms involved in the conception, management or monitoring of the projects while excluding suppliers involved on a commercial basis only. Social enterprises, are indicated in brackets. In

the Academia column, we include universities and public research organizations. Finally, in the Citizens column, we indicate the segment of the population involved at levels of engagement that vary from beneficiaries to participants to key players. A list of activities carried out for each project is available in Annex 3.

### 6.1 Mur|Mur

This program was initiated by the Grenoble metropolitan community (the local authority previous to the GAM) in 2009. It was relaunched as a second phase called Mur|Mur II. Its objective is to reduce residential energy consumption by promoting and funding the thermal renovation of private homes and apartments in the Grenoble area. Private owners are supported all along the project life cycle including financial aid. The program aims to create favorable conditions for the decision to renovate and improve housing insulation. The program itself is executed by the local energy agency (ALEC). As such, it operates as the operational 'arm' of the Grenoble administration. ALEC was an independent association until 2020, afterward it was partially integrated as an additional service within the GAM.

At the time of writing, this project helped the renovation of more than 15,000 residences. Although this represents only 10% of all single-family homes, it is considered a success by the administration and other stakeholders, as the initially set objectives were achieved. The stakeholders classified by helix type are listed in Table 1.

**Table 1:** *Mur|Mur*

| Government | Business | Citizens | Academia | HAO |
|---|---|---|---|---|
| Grenoble-Alpes Métropole (initiator) | Contractors | Homeowners (beneficiaries) | - | ALEC (Local Agency for the Environment and the Climate) |

### 6.2 Chair HOPE

The Chair HOPE was initiated in 2018 by the Grenoble INP Foundation (an emanation of the Grenoble Engineering University), and its partners. Its scope was to mobilize economic and political actors to innovate in the fight against energy poverty. Energy poverty has an impact on the economy, health, and environment. The Chair was planned to work for approximately three years.

Energy poverty is a challenge with multiple dimensions. "Student Dynamics" is a specific action within the scope of Chair HOPE. Its objective is to raise awareness and mobilize students regarding the topic of energy poverty. By doing so the initiators hope that energy poverty will become a widely recognized issue within the

different fields of research and courses focused on energy, technological or social, rather than treating it as a separate challenge.

The "Student Dynamics" initiative is still recent. Moreover, since the objective is awareness-raising, it is hard to measure its impact. However, some first successes have been observed. For example, some students continued working on projects related to the subject even after the completion of the mandatory course. The Chair HOPE was invited by the French Ministry for Ecological Transition in September 2020 to receive an award for the "Student Dynamics" initiative. The action has resulted in networking and new opportunities to combine knowledge and insights to further advance the energy poverty topic. The stakeholders are listed in Table 2.

**Table 2:** *Chair HOPE*

| Government | Business | Citizens | Academia | HAO |
|---|---|---|---|---|
| Grenoble-Alpes Métropole<br>Department of Drome<br>Agglomeration of Roanne | EDF<br>GEG (social enterprise)<br>Rexel<br>Schneider Electric | Energy-poor citizens (beneficiaries) | Chair HOPE<br>Grenoble INP Foundation (initiator)<br>CEA research lab<br>University of Grenoble-Alpes | Innoenergy<br>Tennerdis cluster |

### 6.3 Energ'Y Citoyennes

Energ'Y Citoyennes is technically a private company, but run by volunteers. Its scope is to mobilize local savings to invest locally in energy projects, initiated and developed by citizens. Citizens can be shareholders and, if interested, volunteers. The focus lies on solar and photovoltaic (PV) installations. About 20% of capital expenses come from citizens and local partners. Moreover, they have financial participation in other energy initiatives such a small local heat network using wood as a fuel.

Several interviewees cited this initiative as a successful example of citizens taking charge of energy issues. At the time of writing, this initiative had almost 300 shareholder citizens and commissioned 15 PV installations mainly on the roofs of public buildings (for a total of 280 kW installed). It was said that it empowered citizens giving them confidence that they can deliver professional work and be in charge of energy decisions. The stakeholders are listed in Table 3.

**Table 3:** *Energ'Y Citoyennes*

| Government | Business | Citizens | Academia | HAO |
|---|---|---|---|---|
| Grenoble-Alpes Métropole<br>Municipalities of the metropolitan area | Enercoop (social enterprise) | Volunteers for project investing and development | - | ALEC |

### 6.4 Metro Energy

The scope of this project is to make Open Data related to energy available to citizens and firms. It is a collaborative energy data management tool for cities and citizens. By sharing data on an open platform, this tool and applications that can be developed to leverage data could help citizens and cities improve their energy management.

From the interviews it emerges that the impact of this initiative did not live up to the expectations and ambitions. The engagement of people to actively monitor their consumption of heat, electricity and water was a challenge, even those who were motivated initially. Therefore, there was little impact on energy consumption, possibly because the amount of money at stake was not big. The stakeholders are listed in Table 4.

**Table 4:** *Metro Energy*

| Government | Business | Citizens | Academia | HAO |
|---|---|---|---|---|
| Grenoble-Alpes Métropole<br>Municipalities of the metropolitan area | GEG (initiator) (social enterprise)<br>ATOS | Volunteers for trial and development | - | ALEC |

### 6.5 CCAS

The Centre Communal d'Action Sociale (CCAS) is an organization involved in social action and it is part of the social services of the Grenoble municipal administration. Its role is to support households in financial difficulty. As such, it also encounters families suffering from energy poverty. With the help of local energy providers, it gives information about energy and helps many citizens improve their energy use and management.

After a socio-technical diagnosis of the family's energy use and management, only one briefing is organized with them. According to the interviews, this service is generally useful, though it is difficult to measure an impact without a systematic follow-up. The stakeholders are listed in Table 5.

In terms of governance, it was reported that because the number of relevant stakeholders is increasing, coordination with them becomes more difficult. This takes time and resources away from the mission of fighting energy poverty.

**Table 5:** *CCAS*

| Government | Business | Citizens | Academia | HAO |
|---|---|---|---|---|
| CCAS<br>Municipality of Grenoble | GEG<br>(social enterprise) | Energy-poor citizens<br>(beneficiaries) | - | - |

### 6.6 Lancey Energy Storage

This case has a strong technological component that is not SI-driven. However, we included it in the list because it was mentioned by the interviewees as a relevant public policy initiative with social impact. Lancey Energy Storage is a company founded in 2016. They developed an intelligent heater with an integrated battery and smart management system. Optimizing the exchanges of electricity with the grid, their objective is to make energy more sustainable by improving thermal comfort while reducing energy consumption. Moreover, the batteries come from those utilized by the postmen's e-bikes.

The company received the Best Innovation Award at the Consumer Electronics Show in Las Vegas in 2018, a prestigious international recognition for this innovative space heating solution. Lancey's product was adopted by public administrations such as the Grenoble municipal and metropolitan authorities through procurement for innovation procedure (Uyarra et al., 2014). The Lancey's heaters combined in the network represent more than 1 MW of energy storage that can be used also for grid balancing. The stakeholders are listed in Table 6.

**Table 6:** *Lancey Energy Storage*

| Government | Business | Citizens | Academia | HAO |
|---|---|---|---|---|
| Grenoble-Alpes Métropole<br>Municipality of Grenoble | Social housing organizations (social enterprise) | Social housing inhabitants (indirect beneficiaries) | CEA | Tennerdis |

## 7. Discussion and Analysis

Table 7 summarizes the cases introduced in the previous section. In this piece of research, we do not delve into success or failure factors, so we do not discuss in depth the reasons for project outcomes. Instead, our objective is to describe which helices these SI leverage and therefore to induct general characteristics of SI in energy.

To begin with, despite our cases coming all from the same territory, the variety of subjects and institutional settings that we found confirms that SI in energy goes well beyond the mission of traditional electric utilities and more generally power generation, transmission, and distribution. SI may entail consumers' education, more rational use of resources, access to electricity at fair conditions, the adoption of more sustainable technologies, and the governance of decentralized generation. SI is mostly about people's behavior and attitudes, and when technology is involved (such as in the cases of Lancey and Metro Energy), innovation could not be successful without the engagement of other spheres.

Moreover, we observed that all of our cases emerged via either a TH or a QH (see table 7). Several respondents reported that understanding regulations and managing stakeholders' expectations were the biggest challenges. The energy system, with its complex regulation and multi-level governance, is not an easy target for change. In order to succeed, SI should first and foremost cut through the bureaucratic layers that regulate the sector. This implies that SI in energy can be done with good knowledge of the norms and legislation and requires the collaboration of a diverse pool of stakeholder to emerge. Besides, an HAO is present in most projects, playing the role of broker involving citizens to various extents.

Furthermore, when taking a closer look at the type of stakeholders that are involved in our cases, we can notice three specificities for SI in energy. First, local public administrations rather than national governmental bodies are involved. This is not surprising given that SI in energy materialize at the local level. A respondent even said that in his eyes there is little difference between SI and a good public policy, indeed public policies can be socially innovative. Nevertheless, this highlights the central role that has to be played by the Government and the need for local public actors to acquire

the competences needed to fulfil this role. This resonates with similar arguments proposed by other scholars (Sovacool et al, 2023; Vernay et al, 2023).

Second, when looking at the business helix, we observe that, often, the firms involved are SEs. This is consistent with the aims of SI. However, this does not imply that for-profit firms cannot contribute to SI.

Last but not least, the TH twin Government, Business, Citizens characterizes four of our cases, i.e. SI emerged without universities. Whereas, academic stakeholders are a key pillar of the original TH framework (Etzkowitz & Zhou, 2006). Their absence may point to possible weaknesses of these cases. Possibly, projects such as Metro Energy could have been more successful if social scientists had been involved. It has been earlier argued that most universities fail to systematically engage with SI. According to Cinar & Benneworth (2021), the problem lies in their institutional logic: academics engage in social issues as they were enterprise projects managed through contract research or industry collaboration. However, social scientists should contribute more to the energy transition because they can interact with citizens better than engineers.

**Table 7:** *Cases Overview*

| **Case** | **Main goal** | **Key actor(s)/ Initiator** | **Helix configuration** | **Type of SI** |
|---|---|---|---|---|
| Mur\|Mur | Thermal renovation | Local public administration | TH (Government, SE, Citizens) with a broker organization (HAO) | With Citizens |
| Hope | Energy poverty reduction | University | QH (Government, SE, Academia, Citizens) | For Citizens |
| Energ'y Citoyennes | Access to renewables | HAO / Social business | TH (Government, SE, Citizens) with a broker organization (HAO) | By Citizens |
| Metro Energy | Open Data | Local public administration | TH (Government, SE, Citizens) with a broker organization (HAO) | With Citizens (potentially) |
| CCAS | Energy poverty reduction | Local public administration | TH (Government, SE, Citizens) with a broker organization (HAO) | For Citizens |
| Lancey Storage | Efficient use of energy – Procurement for Innovation | Local public administration + Business | QH (Government, Enterprises, Academia, Citizens) | For Citizens |

Finally, concerning the level of citizens' participation in our SI cases, we can say that in half of them (HOPE, CCAS and Lancey) citizens are mainly passive beneficiaries, so these projects are "for citizens". The Mur|Mur project is carried out "with citizens". The Metro Energy project, sharing energy-related open data to interested users, was meant to be a SI "for citizens", with the potential to become "with citizens". The most bottom-up case in this study is Energ'y Citoyennes, the

only case of SI "by citizens". In this project, engaged citizens help other citizens to install and maintain solar equipment. While this project is unanimously considered a success, our respondents argued that it has little room for growth. Indeed, the project relies on a core group of activists. The fact that at least one case is "by citizens" demonstrates that in Grenoble there is a significant segment of the population actively engaged in the energy transition. Moreover, environmentally conscious, socially oriented local government has a key role. These factors are not so common elsewhere.

### 7.1 Implications for Policymakers

The government is central in the heavily regulated energy system, no matter the kind of innovation. In democracies, government is the direct expression of citizens' will, but governance and decision-making should not be limited to the time of elections. When local and national administrations, universities and businesses do not involve citizens, leaving them in a passive role, the risk of backlash or limited traction is very high. Moreover, we have seen that there is no SI without civil society and citizens. Depending on the circumstances, this may happen to a different extent and through various modalities. It may be done through participatory events, or by involving activist associations or co-opting engaged citizens.

If the beneficiaries do not have the knowledge necessary to select the solutions or the resources to implement them, QH HAOs as well as SEs may be the implementers.

The engagement of citizens is a gradual process that takes time, competencies and political will. A starting point could be the creation of open institutional platforms devoted to the energy transition where citizens find information and technical assistance, learn about issues and options, coalesce around common initiatives, and provide inputs and feedback to the policymakers. This may be done only if government is keen on such an evolution of its role towards more "entrepreneurial" activities. In particular, SI is based on heterarchical institutional settings, where government is either the driver (primus inter pares) or other non-state actors are driving (self-regulation).

## Conclusions

This piece of research aimed at discussing if and how the helix-based models of innovation can describe and foster SI. We analyzed six energy-related initiatives in Grenoble identifying the main stakeholders and to which extent citizens were involved.

SI is a powerful form of innovation despite the ambiguity of its definition and boundaries. We believe that SI can and should complement technological innovation to accelerate the energy transition. While SI should benefit citizens, it is advisable to carry out such initiatives involving them in project conception and management.

Despite the limitations due to the limited number and specificity of the cases, the study suggests that the TH/QH model is relevant also to SI, at least in democratic countries where a civil society exists. We found that in several cases, civil society replaces the university helix. However, we cannot exclude that social scientists would be more useful than technologists in projects targeting the Civil Society. This may be the object of further research.

Given the complexity of energy issues, HAOs can broker knowledge and resources between spheres. We have here extended the concept of HAO to the QH setting. Indeed, collaboration with other stakeholders is key in this sector. "It takes a lot of energy to address energy issues" was a comment by a respondent.

However this raises the question of the possibility of carrying out social innovation in the energy sector without the presence of HAOs. Based on the empirical evidence from our cases, we believe that only when there is a strong political will and somewhat ideological convictions at several levels in the institutions, the local government, together with social enterprises, can drive SI. This is particularly evident in Grenoble.

Our analysis shows cases where citizens are pure beneficiaries, which we call "for citizens", others in which people have a say, whether in conception and/or implementation, and we call this kind of SI "with citizens", and finally the projects "by citizens" are when people are those who drive the action. Most SI projects of our study related to the first two levels of engagement.

Though our findings are mostly significant at the local level, we believe that the energy transition is less likely and slower without SI, and that SI innovation cannot happen in spite of citizens. No matter their role, the more they feel involved, the better they will respond. The effort that scholars and government should do is to design and establish settings conducive to SI.

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**Annex 1 - List of Questions**

Introduction by the interviewer(s):

As stated earlier in our email, we are interested in understanding the social and political dynamics around social innovation in the energy sector in your city.

By social innovation in the energy sector we mean all types of innovation in the energy sector that are not strictly or solely technical.

While a technical innovation would be for example the technical improvement of photovoltaic solar cells, a social innovation would be new forms of organization of the production and distribution of energy with solar photovoltaic through energy cooperatives or peer-to-peer energy trading.

Here are other examples:

- provision of eco-efficient housing in collaboration
- advocacy for or against specific energy sectors
- participation or organization of energy-related events
- organization of investment and financing mechanisms,
- energy gamification and gamification applications.

All of these examples have in common that they refer to combinations of ideas, objects or actions that change social relationships and involve new ways of doing, thinking and / or organizing energy. In addition, a new combination of existing ideas, objects or actions can be socially innovative.

In this interview, we particularly want to understand the role of networks, politics and power relations. It consists of 4 main parts, each with several questions:

1. Innovation in the energy sector in the city
2. Networks
3. Politics
4. Power

1. Innovation in the energy sector

What are the projects you are working on that are directly or indirectly related to energy?

From your point of view, among these projects, which are the most innovative?

Can you describe the innovative energy initiatives that you consider to be the most important in your city?

What are the different roles your organization plays in relation to innovative energy initiatives in your city?

2. Networks

In this section, we would like to better understand how relationships and networks enable and/or hinder energy innovation in your city.

Who do you work with? How do these relationships enable and support your organization and other organizations to be socially innovative in energy?

Can you tell us more about how the favorable relationships developed?

Can you tell us more about how these relationships hamper your organization and other organizations/initiatives to contribute to social innovations in the field of energy?

3. Perception of the political process

In this section, we look at how the voice and interests of energy SI are taken into account by policy makers in your city and beyond.

How do you interact with the municipal administration and the city's political decision-makers?

Can you tell me how you usually participate in the policy development processes that are important to your SI initiative?

4. Power relations

In your opinion, which organizations are the most powerful in your city when it comes to energy?

How would you characterize the relationship this powerful actor has with you? with SI in your city?

Who exerts a counter power against the most influential organizations? Otherwise, is there a need for checks and balances? In your opinion, what could be the strategies to increase this counter-power?

Other questions

What have you managed to achieve in terms of social innovation?

You are most proud on which project? The least proud?

How could you have done a certain project differently with hindsight?

What do you expect from other energy SI plzyers? Are the most complementary? Or too much overlap?

## Annex 2 - List of Interviews

| Organization | Type of stakeholder | Date | Duration |
|---|---|---|---|
| City of Grenoble (Energy Transition Department) | Local Government | 16/10/2020 | 0h50 |
| GEG (Energy provider) | Energy Utility | 06/11/2020 | 1h10 |
| Lancey Energy Storage | Small Enterprise | 12/11/2020 | 1h10 |

| | | | |
|---|---|---|---|
| Grenoble Agence d'Urbanisme (Urban Planning Body) | Public Agency | 16/11/2020 | 0h55 |
| ALEC (local energy agency) | Public Agency | 12/11/2020 | 1h00 |
| City of Grenoble (EU Green City project manager) | Local Government | 19/11/2020 | 0h55 |
| CCAS | Local Government | 19/11/2020 | 0h50 |
| INP Foundation | University/ Engineering School | 17/11/2020 | 1h05 |
| Energ'Y Citoyennes | Energy Community | 03/12/2020 | 0h50 |
| Mayor of La Tronche Municipality | Politician and local administrator | 01/12/2020 | 1h00 |

## Annex 3 – Case activities

### Mur|Mur

- Advice and feasibility study by ALEC, help set-up financial plan, support acceptance of work and energy consumption
- ALEC: help home owners in project start-up and execution.
- ALEC has expert and/or animator role
- Information sharing, financial support
- Set-up of “one desk or one entry point” for home owners to contact and work with contractors
- Create links / network between different market players
- ALEC ensures/observes proper execution according to Metropolitan rules
- Ensure that different contractors have the proper qualifications for renovation works, i.e. certify companies

### Chair Hope

- Raise awareness among students in Grenoble and at a national level
- Ensure that the subject of energy poverty is not treated as an isolated topic, but integrated into the teaching curriculum and research as an element of education and research in the domain of energy.
- Evaluation of projects and actions with HOPE partners

- Involvement of elected representatives around the projects/subjects carried out by the students.
- Create a national network related to energy poverty.

**Energ'Y Citoyennes**
- Project initiated with the help of the Grenoble Metropolitan Authority
- Volunteering citizens identify buildings and roofs and develop projects working with local partners (Enercoop, ALEC, equipment suppliers)
- Fundraising among Grenoble population
- Citizens are in charge of energy issues and deal with local politicians
- The project fosters energy awareness and instills confidence that citizens can manage energy topics

**Metro Energy**
- Data collection by smart meters installed in homes
- To improve decision-making and behaviors, collected data are integrated into a platform and made available to consumers, network operators, and producers.
- City administrators can monitor if they are on track to reach energy and climate plan targets
- Citizens can see their real-time energy use and compare it with other users

**CCAS**
- Track families that experience energy poverty (by GEG, the local utility)
- Carry out a socio-technical diagnosis
- Install energy-saving equipment in family homes
- Raise their awareness of potential energy savings
- Help them to control their consumption
- Refer them to other support or intervention devices when necessary
- Perform "small" thermal comfort work

**Lancey**
- Spin off of CEA
- Space heating that integrates smart energy management
- Give a second life to batteries from electric bikes (from La Poste), by integrating them into the heater
- Charge batteries when energy is cheap as during the night, discharge through heating during the day when energy is more expensive

- Connect with solar panels for auto-consumption
- Provide energy storage and grid balancing through the interconnection of all installed batteries

**Notes**

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