Community-based solar projects: sun-sharing politics and collective resource construction trials

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Abstract:

In many respects, France's solar photovoltaic policy jump-started the development of what could be called "individual" photovoltaic projects: one project, one roof, one owner. Given this policy framing, projects that pursue an alternative approach to solar development (more-than-individual investment strategies) have to channel their assembling in different ways. This paper investigates community-based solar experiments – the "centrales villageoises" in south-eastern France's Rhône-Alpes region. This approach is innovative as it consists in assembling multiple panels on multiple roofs with mixed (public and private) owners. The analysis follows these emerging collective solar projects as a matter of binding together a large set of heterogeneous materialities, such as panels, roofs, buildings, electricity grid network and landscapes, and providing them with a shared status. We argue that the solar resource is defined along with these emerging socio-technical systems. Thus, its appreciation as a "common good" (or lack of such) relies on methods, tools and capacities that allow protagonists to have flexibility in forming material entanglements endowed with a collective dimension – sharing roofs, investments, risks and gains. Finally, the analysis shows that a fair solar energy project is one that not only fairly redistributes the benefits but also, in the long run, preserves the possibility of having collective discussions on diverse dimensions, especially the integration of social and landscape-related issues (landscape of justice) within the solar energy's development agenda.

1. Introduction

Despite the numerous arguments in favour of increasing and accelerating the energy transition (depletion of fossil fuels, rise in carbon emissions), the ongoing development of renewable energies still faces many hurdles and what has been called carbon locks-in (Unruh 2000, 2002). Some academic researchers approach the emergence of local energy initiatives as a potential means to overcome these hurdles (Dóci, Vasileiadou, and Petersen 2015; Walker 2008; Walker et al. 2010) and create posi- tive renewable energy development terms (Catney et al. 2014). Among these positive terms, one key question deals with the capacity of local energy initiatives to improve the distribution of renewable energy profits by putting them within reach of a wider range of actors (Aitken 2010; Allan, Mcgregor, and Swales 2011; Cowell, Bristow, and Munday 2011).

This paper argues that the construction of local renewable energy initiatives not only acts as a way to redistribute the renewable energy incomes but mainly questions the construction of the energy resource itself and its collective appreciation as a "common" (Ostrom 1990). Following processes of community-based solar developments, the paper specifically analyses how solar energy is "commonised" and configured (or not) as a collective resource. The interwoven analyses of the emergence of a local energy initiative and the characterisation of a (solar) resource offer a worthwhile insight into energy justice issues. Beyond the unique scope of distributional justice, these processes are examined in the light of issues of gaining access to and constructing the resources. Indeed, the goal of the collective solar initiatives is not only to maximise their projects' economic outcomes but also to con- struct and maintain greater collective qualities of the resource. Thus, they struggle to produce both a new energy landscape and a landscape of justice (Mitchell 2003).

This paper seeks to tackle these issues while focusing on a critical case study: the French context of photovoltaic development. French solar policy (feed-in tariff, grid management, costs and procedures of grid connection) has mainly triggered the development of what could be called "individual" photo- voltaic projects: one project, one roof, one owner. This French policy has led to the rapid growth of a new solar energy landscape comprising myriad small individual units of solar energy production. This widespread phenomenon drives us to learn from alternative and more concerted approaches to the solar resource.

In this context, our conception of what a resource is goes beyond how the notion tends to be understood. A resource not only refers to the result of a socio-technical process of production but also encompasses all the materialities summoned during the production process. Thus, the solar resource is neither only the solar rays nor the usable electricity generated after these solar rays have come into contact with a photovoltaic panel. The term solar energy resource also encompasses the electric grid (electric lines, substations), the roofs that might host the photovoltaic panels, the photovoltaic panels and the elements of the landscape within which the solar energy projects are developed.

This paper starts with a focus on the context of French photovoltaic policy and the way in which it frames and constrains the development of local solar energy initiatives (§1); it then proceeds with the analytical proposition to tackle – by using assemblage thinking theory – the processes of both solar resource and collective solar project construction, as well as the energy issues these processes raise (§2). The analytical proposition is tested with an analysis of two specific collective solar energy pro- jects within the French context (§3). Finally, several of the discussion's elements are drawn from this analysis regarding the issues raised by our approach of the solar energy resource (§4).

2. An examination of the qualitative outcomes of French photovoltaic policy

Since the early 2000s, the French government has adapted its energy policy more and more to its international commitments.1 As a result, in the wake of the European agenda on renewable energy production, French solar photovoltaic policy is primarily structured around quantitative contribution goals with regard to the national electric mix. This policy sets up favourable technical and economic conditions to trigger massive photovoltaic developments without considering qualitative and multidimensional issues on the local scale. This policy's unique dimension primarily targeted the development of photovoltaic systems on roofs rather than on the ground. Beyond this quantitative framework, France's photovoltaic policy appears to trigger specific forms of photovoltaic development – mostly large industrial operations or small-sized private operations on residential roofs.

These photovoltaic developments emerged from three main strands of action: a feed-in-tariff scheme, grid connection and grid reinforcement policies and, finally, tax credits. Since its first implementation in 2002, the feed-in-tariff scheme has been regulated by the French government but has constantly overflowed as a result of numerous unforeseen developments on the market (Cointe 2014, 2015). The regulation of the scheme related to both the value of the feed-in tariff and the conditions for its attribution. With the creation of many different tariff categories in accordance with roof and integration criteria (surfaces of panels, building uses, integration modalities of the panels), the scheme quickly became more complicated. Then, the purchase agreement that set the feed-in tariff between the EDF (Electricité de France) and the electricity producers depends on every operation being connected to the electric grid. By decree, the French government determines the share of responsibility for grid connection (from 0% to 100% at the expense of the electricity producer) and the possible costs for reinforcing the grid. Before the passage of the NOME (New Organisation for Electricity Market) Law at the end of 2010, the costs had been shared equally between the photovoltaic-electricity producer and the EDF, whose public service mission is renewable energy development; ever since, however, the producer has had to foot the bill. This decision might not be of any consequence to large producers but certainly affects smaller producers, especially those who need to cover the cost of the grid-reinforcement operations. Finally, France's solar photovoltaic development is supported by various tax credits meant for households to acquire panels and photovoltaic-related benefits for small operations, which means that collective projects cannot benefit from these credits.

In this context, each roof has a unique economic profitability potential. This profitability potential might vary drastically from one roof to the next within the same neighbourhood, even if they benefit from the same exposure to sunlight and present similar solar orientations, low-slope roofs and no solar masks. Therefore, this framework makes the emergence of collective solar projects more com- plicated. A project developer seeking to capitalise on the emergence of collective photovoltaic operations faces many difficulties in gathering roofs and bringing together roof owners. As a result, the French photovoltaic policy primarily triggers a private and individual form of photovoltaic development.

As shown by recent studies, only a few collective photovoltaic projects have been developed in France2 (Devisse, Gilbert, and Reix 2016), although their number has been rising steadily (Nadaï et al. 2015; Yalçın-Riollet, Garabuau-Moussaoui, and Szuba 2014). This evolution is supported by the work of NGOs comparing different legal frameworks (Poize 2015; Poize and Rüdinger 2014) and offering a collective financing scheme (e.g. Energie Partagée) to guide collective photovoltaic initiatives along a more suitable path. Within this increasing number of collective operations, there is a wide range of projects regarding the type of development (Devisse, Gilbert, and Reix 2016).

This paper does not tackle the causes of these collective solar developments but examines their potential contributions to an energy transition in the making. Based on two case studies, the paper focuses on emerging solar cooperatives and questions their strategies to "commonise" the solar energy resource. The examination of these case studies provides some elements to answer our main questions: (1) How are these solar energy cooperative projects developed, and what are the difficulties they face? (2) What makes these collective operations more innovative than individual investments in solar energy? Do they constitute new ways of resource grabbing, or do they implement new forms of re-distributing benefits (Jenkins et al. 2016)? (3) And finally, do these collective projects encourage a commonisation of the solar resource, and do they offer new perspectives on energy justice (Dardot and Laval 2015; Moss, Becker, and Naumann 2014; Nayak and Berkes 2011)?

3. Solar energy collectives as dynamic assemblages

Materiality is recognised for playing a central role in the construction and valorisation of energy resources (Bridge 2010; Kaup 2008; Mitchell 2011). The focus on the role of materiality brings attention to relational dynamics in the process of resource commodification. In this context, we study how these relational dynamics bring specific values to the solar energy resource. The qualities of a resource – the types of values and uses it is related with – do not emerge from physics (e.g. the sun's rays) but from a relational process of construction that engages a multiplicity of materialities (e.g. photovoltaic panels, buildings, roofs, electric grid, landscape ...) and power relations in a place.

The present case studies deal with local attempts to harness the sun's energy and produce electricity. As a starting point, one could emphasise the material specificity of the sun as an energy resource. Unlike coal or oil, the sun is a diffuse energy resource. It needs to be concentrated (from solar radiation to the panels to the grid) in order to produce kilowatt-hours. From a large solar plant to individual small-sized operations, this operation may take various forms, but in all cases a broad range of materialities are needed to produce energy from the sun. In this paper, "resource" refers to all the entities engaged in this process of producing electricity: sun, buildings, landscapes, territories etc. Turning the sun into kilowatt-hours raises the practical issue of turning a territory into a unit of power production.

As a starting point, this paper proposes specifying the way in which the sun and its related materialities enter the process of concentration. In our case studies, what makes the concentration of solar energy very distinctive is the process of pooling roofs distributed across a wide area to create a power generation unit. Thus, the solar energy resource's qualities would emerge from the way roofs are locally pooled and envisioned as a shared materiality to produce electricity. The operation of pooling and sharing a common materiality is challenged by the diversity of statuses and qualities the roofs are attached to (ownership, property value, familial or professional values, architecture, urbanism, landscape, connection to the electric grid, feed-in-tariff category). In addition, in the French context, community-based solar projects face high levels of uncertainty and have to adapt to critical technical and economic conditions. Thus, the gathering of roofs to collect energy from the sun often follows non-linear processes and sometimes ends up failing as a collective approach, which leads to separate private individual projects making a comeback. Figuring out these processes requires a specific investigation of assemblage thinking and ANT in order to gain a better understand- ing of the dynamic growth of assemblages.

In the field of human geography, the analysis of materiality and relational dynamics has largely been fuelled by the mostly convergent, although distinct, ANT and assemblage thinking theories (Müller and Schurr 2016, 217). This paper engages specifically with assemblage thinking as a meth- odological point of view to tackle the uncertainty of an energy transition "in the making" (Baker and McGuirk 2016; Labussière and Nadaï 2018). However, it also partially engages with ANT in order to capture, by using more empirically grounded concepts (Müller and Schurr 2016, 220), the multifaceted relations between human and non-human actors during the non-linear emergence of solar energy collectives.

Assemblage thinking has been developed in philosophy (Deleuze and Guattari 1987): "an assemblage is a multiplicity made up of heterogeneous terms and which establishes relations between them; the only unity of the assemblage is the one of a co-functioning, it is a symbiosis" (Deleuze and Parnet 1996, 69). Our inquiry into assemblage thinking deals with a specific line of questioning: Does an assemblage have the capacity to manage both its growth and its decline? How does it maintain its identity through non-linear evolutions? And does the attention paid to a resource's materialities provide the analysis with a better understanding of an assemblage's adaptive capacity?

Deleuze and Guattari distinguish between two different kinds of multiplicities underpinning assemblages: "one qualitative and fusional, continuous, the other numerical and homogeneous, discrete" (1987, 484). The "qualitative and fusional" kind is identified as being made up of relations and structured by dimensions – a unity that changes in nature when it is divided. The "numerical and homogeneous" kind of multiplicity comprises metrics, is structured by directions, is a totality that pre-exists its parts and has an unchanging nature when divided. This view offers the first elements to characterise the dynamic of assemblages: Assemblages made up of relations change their intensity when recomposing their materiality. For example,

> one can divide movement into the gallop, trot and walk, but in such a way that what is divided changes in nature at each moment of the division, without any one of these moments entering into the composition of the other (Deleuze and Guattari, 483).

Assemblages composed of added elements do not undergo material transformations when they change. Nevertheless, this approach remains limited when explaining how an assemblage passes from one state to another, that is, from a gallop to a trot and the other way round. The same goes for the consequences of these transformations (growths, decreases) regarding the identity of the assemblage.

Following Deleuze and Guattari, DeLanda (2006) defines the assemblage underlying the clear connection between its materiality and its expressivity (e.g. body language in a face-to-face conversa- tion). These approaches introduce materiality as a resource that allows an assemblage to modulate its capacity for both internal and external coordination. DeLanda focuses on what he calls the "coding/decoding" processes: Many assemblages are not highly coded or territorialised but learn from experience in a more flexible way. Assemblages can adapt to contingency and non-linear evolutions and still maintain their identity to some degree.

This paper's proposal is to characterise: (a) the practical operations used to manage the growth of an assemblage dynamically and (b) the challenges raised by the articulation of heterogeneous (relational, metric) socio-technical assemblages. To advance in this direction, the paper offers two paired notions: to aggregate and to detach as a way to manage the growth and decrease of an assemblage based on relations and dimensions, and to granulate and to subtract as a way to manage assemblages based on metrics and directions. These two pairs of notions describe two heterogeneous ways of gathering the materiality.

The notion of aggregation highlights how project managers patiently construct roof aggregates, how they pool roofs with their individual heterogeneous qualities and how multiple attachments are made to co-exist. The notion of aggregates, as discussed in philosophy (Deleuze and Guattari 1987), suggests a specific relational approach to the ties between individuals and collectives. Contrary to the notion of granulation, which tends to describe an assemblage of entities that compose a new entity in which initial entities stop having an individual existence (e.g. fragments of several different rocks are crushed to make gravel), the notion of an aggregate describes the creation of a new entity in which the initially separate entities still exist as such. The aggregation and granulation operations adhere to different existing philosophical trends. The aggregation operation leads to an understanding of the construction of collective forms with ontological privilege given to relations (Debaise 2006; Simondon 1958; Simondon and Garelli 1995) when the granulation operation tends to provide the ontological privilege to constituted and pre-existing individuals. Exploring collectives as aggregates allows us to overcome the limits of both the holistic and the atomistic approaches. Aggregation is theorised as an operation of the juxtaposition of elements that retain their heterogeneity and not as a modality to create a homogeneous entity. Thus, aggregating is a different operation than adding, assembling, uniting and joining: Aggregating allows the creation of a collective dimension while maintaining capacities to return to a previous stage of existence. It is envisioned as a relational process of making a whole – a mass – out of a heterogeneous materiality. An aggregation may be shaped very differently according to its materiality and its rhythm of growth.

While the notions to aggregate and to granulate refer to two different ways of managing the growth of an assemblage, to detach and to subtract refer to two different operations of reducing assemblages. The relational perspective introduced by the idea of aggregation is continued by that of detachment. Detaching may be the complementary operation to adjust an assemblage without exhausting it by playing on relations through which things are defined and positioned. These are two modalities of arranging multiplicities that make it possible to analyse the dynamics of collective configuration and reconfiguration without assuming a priori what the collective might or should be, as Deleuze and Guattari (1987) suggest. To subtract is a more mathematical operation. In order to make the materiality divisible, subtraction tends to reduce it to its physicality (e.g. the sun as a flow of radiation reducible to its intensity). Thus, the operation of subtracting implies an operation of abstraction, which erases any chance of returning to previous levels of heterogeneity.

Such a theoretical framework leads us to embrace the solar energy cooperative collectives as "relational becomings", that is, their qualities are always uncertain and under construction. Depending on the construction of the collective of roofs, the solar resource also appears to be a "relational becoming", with its qualities emerging from the evolution of the "attachments" between the solar rays, the roofs and various materialities called up during the resource construction process: for example, the electric grid, the landscape and symbolic elements of a place's architecture. The concept of "attachment", as discussed within ANT theory (Gomart and Hennion 1999; Latour 2000), is seized upon as a way to understand the multifaceted relations through which such assemblages are engaged in a process of becoming that is always open to negotiation (Table 1).

This paper goes on to argue that the creation of solar energy collectives raises challenging matters for energy justice. It has been underlined that local experiments of sustainable approaches to solar energy offer stimulating insights into distributional energy justice issues (Jenkins et al. 2016). However, distributional justice relates not only to sharing the benefits allowed by a national high solar feed-in tariff: This paper contends that other dimensions gradually become matters of justice, especially the emerging landscapes of solar energy. Drawing from Mitchell's idea that landscapes are forms of power relations' materialisation, the paper questions whether the emerging landscapes of solar energy are "landscapes of justice or just landscapes" (Mitchell 2003). This question directly refers to the battle for solar energy in the field and – as is the case with the community-based solar model analysed in this paper – how people on the local level are engaged in a struggle against private solar developers to generate alternative ways of making energy and energy landscapes. To discuss this point, we specifically refer to the works of Olwig (2002) and Olwig and Mitchell (2007) on landscape as a dwelling place that is made and transformed through daily practices and discussed and regulated through local assemblies. From this perspective, a land is progressively turned into a landscape while testing collective frameworks that govern local practices on the land. Do these new landscape result from a solar rush led by private interests and a quest for individual private economic profits? Or, on the contrary, do they result from collective and collaborative processes in which more-than-economic collective qualities are constructed? This paper's analytical scope positions the answer to these questions within the debates and day-to-day actions of the com- munity-based solar energy processes of emergence.

Aggregation/detachment and granulation/subtraction are taken as complementary notions to be challenged through the assumption that a cooperative solar entity would result from the collective's capacity to pool materiality and form roof aggregates. This assumption leads us to con- sider the forms of aggregation that actors imagine and the tools and processes they use to seize materiality.

Between 2012 and 2016, we examined these operations behind the construction of solar cooperatives. During the first phase of inquiry, we carried out more than 20 semi-structured interviews with project managers and decision makers (regional technicians and elected officials, local technicians and elected officials, natural park technicians, members and presidents of the solar cooperatives and experts who had worked on the projects, such as architects and landscape and electric-grid experts). We also observed participants at regional and local meetings. In the second phase of the inquiry, we analysed the interviewees' archives with two specific points of focus: the timeline of the projects and the tools and instruments (maps, tables, decision methodologies, participation methodologies) that were designed and used during the projects. Finally, in the third phase of the inquiry, we conducted a few additional semi-structured interviews to gather specific information about what we considered to be key moments and instruments.

Table 1 - Following the dynamic growths of (relational, metric) assemblages.

Dynamics of assemblages	Relational, continuous assemblage	Metric, discontinuous assemblage
Increase	To aggregate • Collective with heterogeneity • Individualities still exist • Collective and individualities co-emerge	To granulate • Collective where heterogeneity disappeared to create homogeneity • Individualities no longer exist • While collective emerge, individualities disappear
Decrease	To detach • Capacity to come back to previous stages or to create minor assemblages to preserve future chances of growth	To subtract • No capacity to come back • The materiality of the resource has to be reduced to its physicality

4. Politics of the sun: pooling roofs to valorise an energy resource

Our assumptions were challenged by the findings obtained through two case studies – two community-based solar energy projects emerging from the same programme, named the "centrales villageoises". This programme is supported through European (European Regional Development Fund) and regional (French administrative region Rhône-Alpes) financial investments and coordinated by the RAEE (Rhône-Alpes Energy and Environment), a regional NGO in charge of energy and environment-related issues. It is an experiment on the constitution of solar energy cooperatives. One expected outcome was the creation of generic tools to help the development of more community-based solar energy projects, as well as the production of an alternative model of photovoltaic development. Such tools aim to cover four distinct challenges: (1) gathering inhabitants and elected officials and getting them involved in the governance and funding of a local cooperative; (2) creating legal tools (company statutes, leases for roofs) that would be adequate for a collective and cooperative operation; (3) con- structing technical and economic tools to select the roofs on the basis of their collective profitability and (4) improving the landscape and architectural integration of solar panels.

Established in 2010, the programme brought together eight pilot operations, all located within natural regional parks. The set of landscape and architectural issues that the RAEE addresses are a testament to its ambition to test energy alternatives on a national level. The RAEE has worked closely with its technical staffs to gather local inhabitants, companies and public authorities around collective solar projects. Starting in the early 1980s, the RAEE developed this partnership to test working methods and foster community-based energy alternatives. These emerging solar cooperative projects allowed the organisation to launch a new wave of experiments, especially to train inhabitants and public authorities to learn how to initiate and manage such community- based projects. This programme led to the emergence of more than 50 community-based solar energy projects (bearing the name “centrales villageoises” or inspired by it) between 2012 and 2017. However, such community-based projects remain marginal within the French solar energy policy arena, and many lessons from their development still have not received much attention.3

The two specific case studies examined in this paper are the pilot operations that started electricity production first. The analysis focuses on how the processes of pooling roofs influenced the valorisation of an energy resource and how the actors ended up dealing with a large array of local and national during this process. Our analytical focus is on the collaborative approaches and the (environ- mental, technical and economical) instruments that project managers mobilised during the process, what these approaches and instruments led them to do, their political effects and the progressive construction of distinct solar energy potentials (Figure 1).

4.1. The Pilat case study: a relational appraisal of sun-related materialities

The first case study was conducted in the northern part of the Pilat Regional Natural Park (hereafter “the Natural Park”) (#1), to the south of Lyon and the east of Saint-Etienne. The initial area of the “centrale villageoise” project is limited to one inter-municipal entity (11 municipalities, 129 km2 in area, with 17,000 inhabitants). Except for the city of Condrieu, which is located in the Rhône Valley and affected by the presence of factories and the influence of Lyon, this is mostly a hilly, rural area. The median income of households in 2013 was €21,000,4 which is near the national average. Most of the area’s mayors and elected officials on the municipal level are very influential as they participate in both the inter-municipal and the Natural Park’s decisions. In this way, the three institutions tend to agree on all decisions regarding the community-based solar project.5

Project developers wanted to generate a solar operation concentrated in space, connecting the roofs of houses and buildings that are located close to each other. During an exploratory phase, they set up a participatory method to define a pilot site from the initial area. The issue was to agree collectively on relevant criteria that would allow the participants to compare potential pilot sites with each other rather than let local political competition manage the selection. This called for discussing solar qualities with respect to local issues. At that time, a team of technicians from the Natural Park steered the project. After a round of public meetings in the area, four municipalities were selected on the basis of their inhabitants’ motivations to join the collective solar project. For these municipalities, the technicians did fieldwork to evaluate roof solar intensities and their landscape co-visibilities. They also interviewed inhabitants to find out more about their desire to be part of a collective solar project. These and other observations (roof surfaces, roof's feed-in-tariff category) were aggregated into a database managed by a geographical information system. The technicians developed a set of maps for every municipality. These maps were made to comprise multiple over- lapping layers that draw on all the datasets the technicians had already gathered, including solar intensities, feed-in-tariff categories, owners' motivations and landscape integration (see Figure 2). They allowed the technicians to identify the first aggregates of roofs. Through these maps, roofs became surfaces on which solar intensity, roof owners' motivations and co-visibilities were made perceptible and comparable. This made it possible to add or remove criteria when discussing the potential pilot sites collectively and to determine pools in which the roofs were individually complying with every register of qualities and collectively endowed with a visual coherence. This exploratory step led to the selection of the village of Les Haies as the pilot site for the programme.

Using these promising aggregates produced with the help of GIS tools, the Natural Park's land- scape architect began exploring the landscape and architecture-related issues of the project in Les Haies. She returned to fieldwork to see, in situ, the roofs (incline, orientation, presence of chimneys, antennas and windows) at various scales (building, village, landscape). This marked a major change to the way the aggregate was considered. Beyond a two-dimensional approach, other principles of aggregating the roofs emerged from this close attention paid to the relationships between the roofs and the buildings, the village and the structuring lines of the landscape. A new solar point of view was produced through this relational work. With sketches and drawings, the landscape architect brought to light two solar energy landscape scenarios (see Figure 3). The first scenario was to organise the potentially myriad photovoltaic panels along one line, well exposed to direct sunlight, consistent with an inherited alignment of houses along a street and underlining the smooth incline of a hill on the other side of the village. The second prioritised two coherent gatherings of buildings: one in the old part of the village, so as to include a public building in the project, and another in a recently developed neighbourhood. These scenarios made it possible to refine solar potentials, deal more precisely with the materiality of things and provide them with a new internal coherence.

In order to estimate the overall cost of these scenarios, project managers asked the grid operator for a cost estimate to connect the projects and asked an engineering office for an estimate to install the panels (#2). At this point, the project was organised around roof aggregates – concentrated in space and individually and collectively expressing various qualities regarding landscape, architecture, owners' motivations, feed-in tariffs and solar exposure. This aggregate's first encounter with the logics of the electric grid and its normativities appeared to be very disruptive. According to his calculation tool, the grid manager looked at the project not as a whole but as the sum of roofs to be divided into individual units. This allowed him to quantify the electricity produced by each panel, identify the panels sharing the same substation and answer the question as to whether a given substation would support these new connections. As a result, the roofs were reduced to surfaces and amounts of electricity. Heterogeneity was no longer considered. Instead of a relational aggregate, the roofs were "granulated", i.e. individualised and reduced to standardised electric qualities. The cooperative solar project fell back into the hands of the inhabitants as a hierarchy of costs to connect each of the panels (from a few hundred to more than 10,000 euros). According to the capacities of the existing grid segments, some operations on several roofs would require grid reinforcement. Such differences in the individual costs of connecting the roofs made the project managers' task of creating a collective project on multiple roofs impossible. At the same time, project managers received cost estimates for the installation of the solar panels. This second quotation detailed the installation costs and the estimated profitability of each individual roof.

Instead of an inclusive appraisal of roofs according to architecture and landscape dimensions, these two quotations introduced a new hierarchy that ranked the roofs according to their costs, benefits and individual profitability. In other words, the cooperative approach, which attempted to share the sun by commonising heterogeneous materialities, was turned into a competition between standardised units.

At this point, project leaders – most of whom are retired inhabitants of different villages in the Natural Park and have experience with activist actions but not with energy-related projects – tried to finalise the roof selection to set up the final funding plan and start installing the panels (#3). During this selection process, roofs were considered according to their individual costs (connection, works) and their profitability. However, project leaders decided to make the final roof selection a matter of cost (what brings roofs together in the project, calculated as euros invested/Wp installed) rather than selecting roofs according to their profitability (difference between the roofs, calculated as euros invested/euros earned) (see Figure 4). This choice allowed some roof options with important qualities for the collective (architecture and landscape integration, selection of symbolic roofs) to continue to exist when they would not have had this possibility in a collective responding to a profit-maximising logic. The challenge was to reduce the size of the assemblage without losing the initial ambition of their alternative solar development. The project managers decided to create two new scenarios of roof aggregation. Both included the roofs with the important collective qualities but with different options of panel integration and selection of additional roofs. Thus, roof selection instruments had more to do with "making a collective" than "making a profit". The final package of roofs was selected according to previous proposals drawn up in earlier stages of the process.

This consisted in reducing the scope of the project by detaching roofs from their heterogeneous assemblage without excluding their owners from the project. The final roof package did not present the spatial coherence expected, as the roofs were not all concentrated in the same area. Nevertheless, some of the initial roof selection's landscape and architecture-related goals were ultimately fulfilled (panel integration, aesthetic coherence of the roof surfaces) (Table 2).

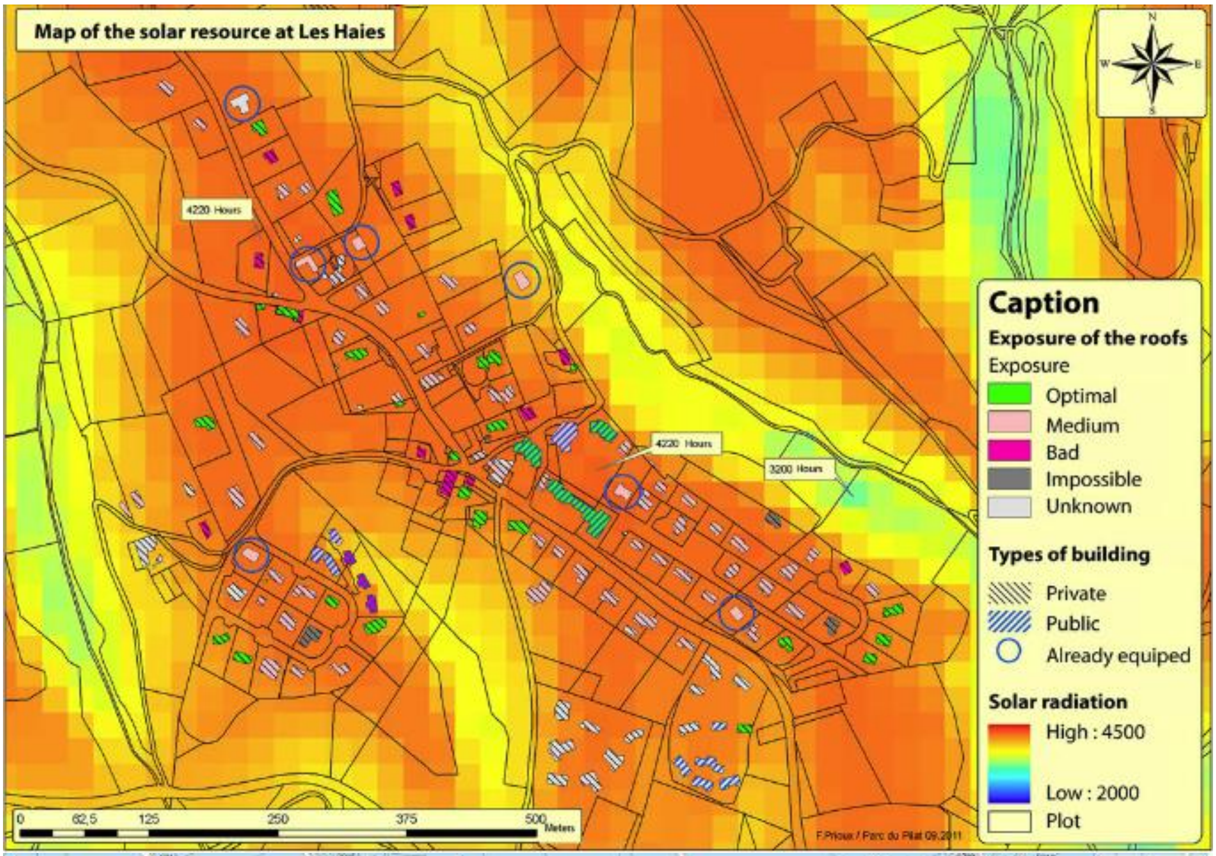
(#1) Project managers tended to aggregate roofs and give them both an internal and an external coherence. Each roof had multiple individual qualities regarding solar intensity, owners' motivations and feed-in-tariff categories. As a group, the selected roofs had an aesthetic coherence from different perspectives: street, neighbourhood and village. The heterogeneous roof qualities emerged through- out the collective construction process.

(#2) The roof aggregate and its qualities did not resist confrontation with the local electric-grid scheme. The previous relational construction was deconstructed. Roofs only tended to be selected according to their homogeneous electric qualities. The spatial and aesthetic continuity among selected roofs was not kept.

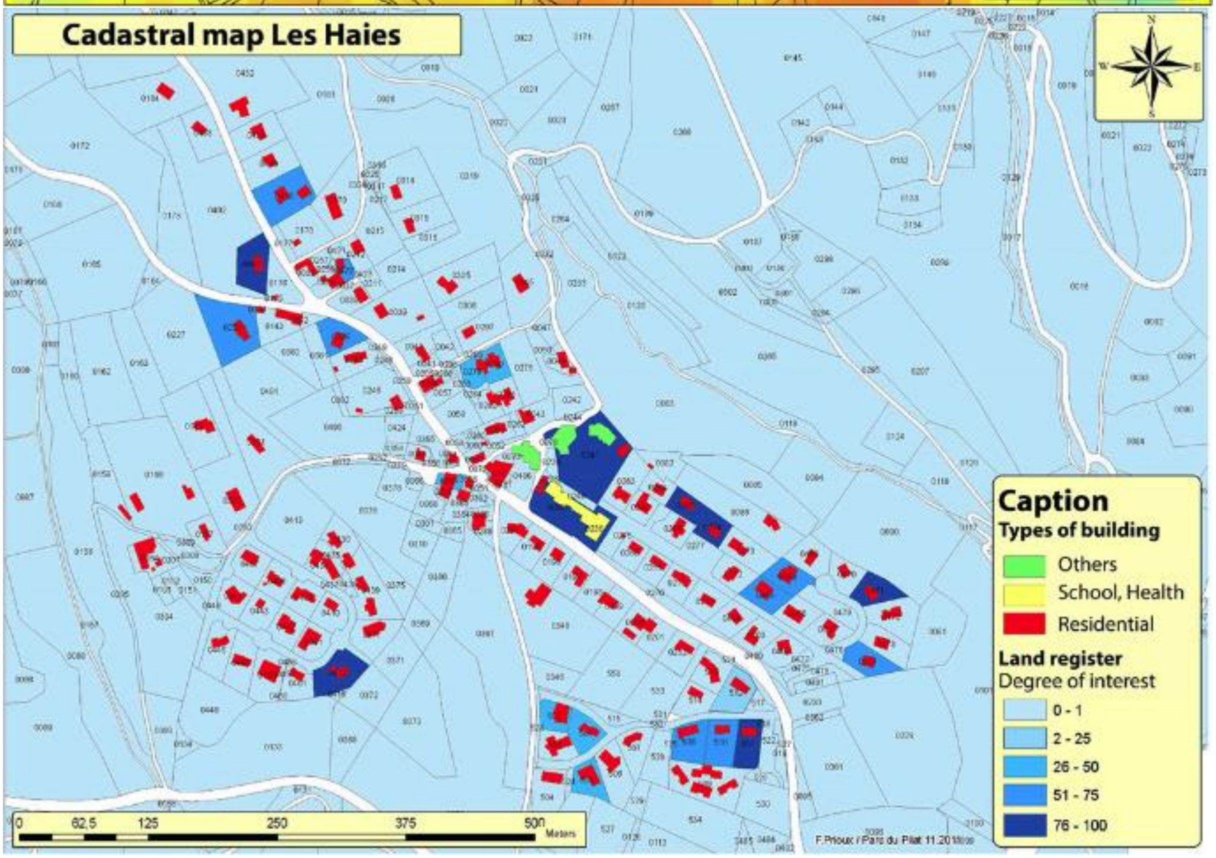
(#3) Project managers decided to return to a previous stage of organisation by reducing the number of roofs within the collective operation but maintained many roofs that were selected in the first place. Electric qualities were not the only selection factor but one factor among many others that had previously been identified. Thus, project managers maintained the collective land- scape and architectural ambitions and did not succumb to economic pressures. The final selection maintained heterogeneous qualities among the roofs, as well as a collective coherence.

Figure 1 - Location of the two solar case studies (Pilat, Bauges). Source: IGN Licence ouverte 2012, Authors.

Figure 2 - Maps of the city of Les Haies (solar intensity, visual impact, roof owners’ motivations). Source: Pilat Regional Natural Park.



Map of the solar resource at Les Haies
4220 Hours
4220 Hours
3200 Hours
Caption
Exposure of the roofs
Exposure
Optimal
Medium
Bad
Impossible
Unknown
Types of building
Private
Public
Already equiped
Solar radiation
High : 4500
Low : 2000
Plot
0 62,5 125 250 375 500 Meters
F.Prioux / Parc du Pilat 09.2011



Cadastral map Les Haies
Caption
Types of building
Others
School, Health
Residential
Land register
Degree of interest
0 - 1
2 - 25
26 - 50
51 - 75
76 - 100
0 62,5 125 250 375 500 Meters
F.Prioux / Parc du Pilat 11.2011

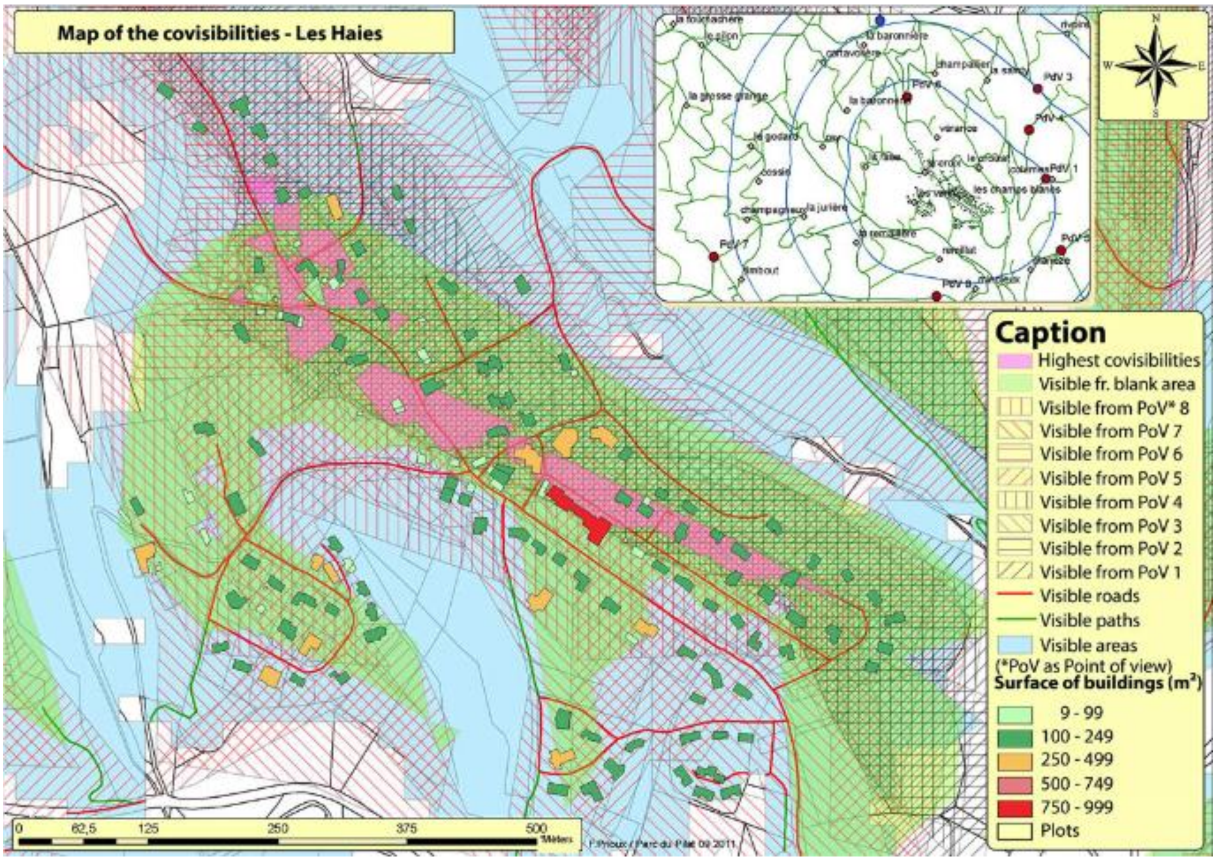


Figure 3 - Scenarios of integration of the solar panels. Source: Pilat Regional Natural Park.

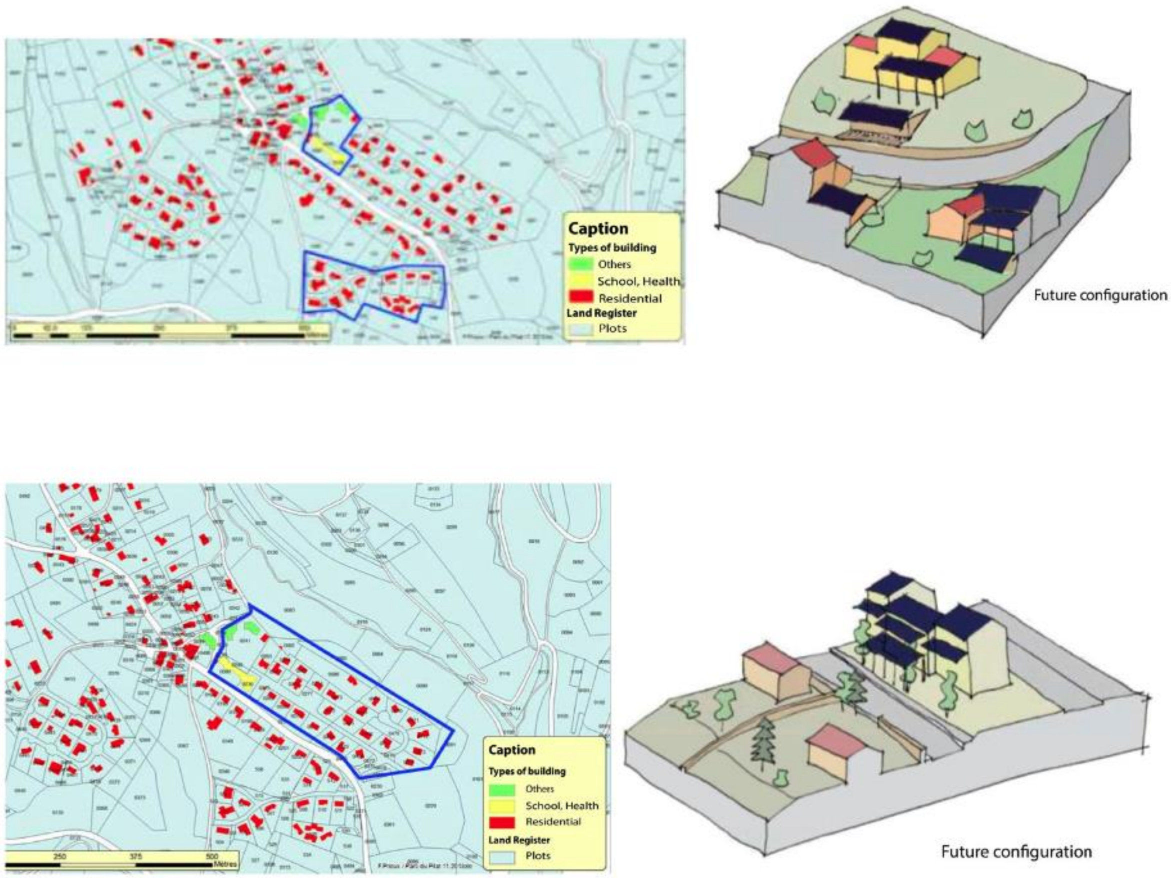


Figure 4 - Roof selection scenarios in a table listing roofs according to the investment/production ratio. Source: Rhônalpénergie- Environnement.

	Scenarios	Power (kWp)	Productivity (kWh/kWp)	Annual Production (kWh)	Investment (€HT)	
					€HT	€HT/Wp
Farm building	1 et 2	48	1 000	47 700	108 300 €	2,3
School «maximum»	1	50	1 045	50 580	147 400 €	3,0
School « 36 kWp »	2	36	1 045	37 620	92 200 €	2,6
City Hall 1	1	36,8	1 031	37 940	93 900 €	2,6
City Hall 2	2	29,6	1 043	30 881	78 600 €	2,7
Social Housing (OPAC)	1 et 2	14,4	1 035	14 905	48 800 €	3,4
House plot nb 196	1 et 2	8,8	1 039	9 140	29 100 €	3,3
House plot nb 296	1 et 2	9	1 040	9 415	28 800 €	3,2
House plot nb 508	1 et 2	9	1 035	9 315	28 800 €	3,2
Total scenario 1		176	1 017	178 995	485 100 €	2,8
Total scenario 2		155	1 027	158 976	414 600 €	2,7

Table 2 - Summary of case study no 1.

Dynamics of assemblages (case study no 1)	Relational, continuous assemblage	Metric, discontinuous assemblage
Increase	To aggregate (#1) →	To granulate (#2)
Decrease	(#3) ↙	

4.2. The Bauges case study: appraisal of sun-related materialities fails to produce a relational perspective

The second case study was carried out in the Massif des Bauges Regional Natural Park, next to the city of Chambéry (#0). The initial area of the "centrale villageoise" project was once again limited to one inter-municipal entity (six municipalities, 101 km2 in area, with 4,000 inhabitants and the same median household income of €21,000 as in the first case study6). Within this area of midsize mountains, mayors and other local elected officials are also involved in the inter-municipal entities' and the Natural Park's decisions and, as in the previous case study, the three institutions work hand in hand with each other.7

The first discussions about a community-based solar project took place among local elected officials serving together on a board. In this rural mountain area, several kilometres separate one village from the next, and these villages are not visible from each other. The elected officials wanted the pilot project to be concentrated in space in order to be as visible as possible. The operation was conceived as a symbol of the area's sustainable development. This point increased the rivalry between the mayors as all of them wished it to be located in their own municipality. Their first decision was to exclude two municipalities because of their remote geographical locations. That decision was based on existing maps showing the areas where road traffic was low and their locations poorly visible.

The solar project really started with the work of a landscape architect hired by the project man- agers to initiate a local dynamic by organising public landscape workshops. It aimed to discuss the issues relating to the development of a photovoltaic project in the area (opportunity to refurbish roofs, visual impacts from one mountainside to the other) with inhabitants. After each meeting, volunteers were equipped with a set of simple tools to explore which roofs in the area were potentially relevant and could be used in the integration of the collective operation. This allowed them to measure the roofs' incline and collect all the basic but necessary information about their solar qualities (estimate of surface, incline, orientation, presence or absence of solar masks, presence of chimneys or windows). On the basis of the roofs that the participants proposed, the landscape architect organised collective field visits to see the roofs in situ and identify the architectural challenges they might pose, as well as their co-visibilities. In the end, however, the approach failed to deliver the first package of roofs because not enough inhabitants attended the meetings to offer proposals.

Although this qualitative appraisal of roofs focused on their relationships with their buildings and surroundings, the project managers decided to run the process of site selection by bringing the four municipal areas' supporters together for a face-to-face debate (#1). A public meeting gathered the inhabitants and the elected officials motivated by the operation, as well as the technicians (from the regional natural park and the RAEE regional association) who managed the project. It aimed to set up criteria to be graded and ranked for the four municipalities, namely visibility, involvement of inhabitants, roof surfaces and orientations. However, if the intention was to avoid making a choice that might produce conflict, the meeting missed its target. The grading system failed to create differences, and the two best candidates ended up with the same ranking (see Figure 5). Furthermore, the solar criteria (solar intensity and roof orientations) as they were set out within the grading system created no differences between the candidates. The only grading differences related to site visibilities and the surfaces of roofs. The arbitrary selection of one pilot site over another was not understood and created conflict, which resulted in all the officials and inhabitants of the municipalities that were not selected quitting the programme. The outcome appeared to be paradoxical in the way the selected pilot site obtained a good grade even though the materialities of the solar project had not really been explored. Conditions for both the roofs and the electric grid were not really known at the time, and there had been no direct contact with the roof owners.

Figure 5 - Pilot-site selection table. Source: Rhônalpénergie-Environnement.

Community-based solar project on the plateau de la Leysse - Site analysis

Ranking from 1 to 3
1 : insufficient 2 : medium 3 : good

		La Thuile		Curienne		Puygros		Thoiry	
Quality of the site	Visibility / attendance / show room effect	From the lake	3	From the road RD11	2	From a country road	1,5	From the road RD 206, from Puygros	2,5
	Public buildings potential	Church 134		Reception Hall 140		Church 240		Church 240	
	m2	Reception Hall 150		City Hall 80		Reception Hall 160		City Hall 40	
		City Hall 100		Restaurant 50				Bed and breakfast 120	
		Social Housing/Church 110		Church 100				City Council garage 200	
		Social Housing/Recept. 100		School 100					
		Gîte communal 50							
		Future City Hall 50		*Futurs city garage building 120*		*Futur parking of the church 170*			
	Total of surfaces	694 m2	3	590 m2	2	520 m2	2	600 m2	3
	Private buildings potential		2		3	Large building in the main village 220	2		3
						Current project on a new farm building ; others potential buildings at Arvey 800m far			
	Refurbishment of roofs potential	Roof of church and reception hall have to be refurbished, old slates	3	Refurbishment potential on the private roofs	3	red slates on private roofs	2	red slates	3
Productivity of the site	Meteorological conditions		3		3		3		3
	Exposure of the roofs	From SE to SW	3	From S to W	2,5	S SE	3	From S to W	2,5
	Far away solar screens	2%	3	2%	3	4%	3	5%	3
	Close solar screens								
Technical crit.	Connection to the grid	2 substations ; 260 kW		4 substations ; 800 kW		2 substations ; 410 kW		1 substations ; 250 kW	
Local commitm.	Others key points (technical, political)			Current project on solar energy					
	Commitment of local actors (inhabitants,mayors)	Commitment of the city a	0	Commitment of the city ass	0		0	Interested inhabitants	0
	TOTAL		20		18,5		16,5		20
	Quality of the site		2,75		2,5		1,875		2,875
	Productivity of the site		2,75		2,75		3		2,8333
	Local Comittment		2,8		0		0		0
	Technical Criteria		2,83333	0,02	2,75		0		0
			2,83333	0,02	2,75		4,875		5,7083

After this meeting, the selected municipality's elected officials started approaching the roof owners to find out more about their motivation to join a collective solar operation. The results of this door-to-door inquiry were entered into a table. This table, which is very descriptive, mentioned every single roof in the area and their respective features (surface, orientation, solar masks and estimated electricity production capacities). In addition, project managers ordered a technical study to estimate the cost of installing panels on every roof for which the owners gave authorisation. However, by registering the owner's motivations in this table, the project managers failed to instil a collective ambition in the project despite their desire to do so. In fact, by using this table, there was an assumption that a community solar project could be built by adding individual solar units. The lack of attention paid to the roofs' materiality and spatial relations tended to "granulate" the solar potential, that is, to standardise its appraisal and eventually hamper the emergence of its collective existence.

At this point, the project managers – a mix of engineers, young entrepreneurs and retired inhabitants with experience in the development of energy-related projects but not with activist actions – used the table to agree on the first package of roofs and to ask for a quotation to evaluate the cost of the grid connection (#2). As in the previous case study, the grid expertise provided the local leaders with a hierarchy of the roofs according to their grid connection costs and zoning by substation. Two of the three areas required reinforcement operations. The group of inhabitants could not cover the costs for these areas. In other words, the photovoltaic project was only achievable if there was an electric substation with enough capacity nearby. Because no siting effort had previously been undertaken, the zoning that the grid manager proposed became the only reason for adding the roof. Thus, the process consisted in subtracting roofs from the initial inventory. The solar and architectural qualities that had barely been identified no longer existed amid this new roofs' surfaces selection process. This reduced the operation of finding the right number of roofs for the electrical grid's capacity. In the light of homogeneous economic and electric qualities, the package of roofs no longer included heterogeneous qualities and did not appear to reflect the programme's initial ambitions.

In order to finalise the roof choice, project managers created a new table to rank every roof according to its individual profitability (euros invested/euros earned). The final roof package was put together based on the overall profitability, calculated as the sum of every roof's individual profit- ability. Through this table, profitability bypassed all other qualities (architecture, landscape, spatial coherence). However, this single economic dimension did not fully ensure the success of the collective operation. At the time, the French government introduced a new category in the feed-in-tariff scheme. Private residential roofs had a greater tariff than public roofs. The reason behind this differentiation was that it seemed easier to obtain roof owners' consent for public roofs because they did not have as many attachments (ownership, property value, familial values, inheritance value) as private residential roofs do. However, the extra profitability that feed-in tariffs provided to private roof reinforced their importance in the project at the expense of public roofs. Along the way, a few private owners discovering how profitable their roof was became reluctant to commit any further to a collective project that was less profitable. At this point, the project managers' calculation tools worked against the construction of the collective. These roof owners eventually refused to include their roofs in the collective project because they felt that they were individually paying for the overall collective costs. As a result, the group split up without any possibility of returning to the previous stage of collective organisation. The collective solar potential was reduced to individual units and private gains.

In the final step of the development process, regional project managers tried to revive the operation (#3). They wanted the operation to be led no longer by local elected officials but only by roof owners and local activists in the field of environment protection and renewable energy. Regional project managers decided to look for these motivations in a larger area by getting rid of the perimeter's previous restrictions (six municipalities). In addition, the French government removed the feed-in-tariff distinction between public and private roofs. Hence, the roof survey was re-oriented. The importance of private residential roofs in the first part of the project prompted the new local project managers to look mainly for public roofs in order to simplify the development. However, the instruments that had previously been used and failed to give roof packages a collective and spatialised dimension were used again. Roofs were selected because of their individual costs. The selected roofs were placed in several remote municipalities without any collective aesthetic coherence. However, project managers succeeded in including innovative options for panel integration on some roofs, even if it meant additional costs for the collective. Roofs included in the collective operation presented homogeneous economic qualities, as well as some specific landscape and architecture qualities (Table 3).

(#0) In the project's first phase, project managers attempted to create roof aggregates in which the roofs present multiple heterogeneous qualities: architecture, landscape integration, orientation, slope, feed-in-tariff categories. However, the participative approach failed because of a lack of local participation.

(#1) As a result, the project managers decided to compile lists of roofs with qualities in tables in order to select suitable roofs without paying attention to their spatial collective coherence. The roof collective was reduced to a list of individual roofs with their individual qualities: what is different rather than what they have in common. Consequently, the selection of the roofs that aimed to lead to the construction of the collective tended to create a roof granulate with shared homogeneous qualities.

(#2) This roof collective was drastically reduced due to grid-connection costs. Grid-connection costs were added in the roof summary tables and became one of the most decisive selection factors. However, the reduction in the number of roofs did not retain the collective as intended but instead led to its collapse.

(#3) In the end, the project managers decided to restart the process of collective photovoltaic operation construction by using the same instruments. Thus, the new group of roofs was selected according to homogeneous qualities they shared and did not emerge from a relational approach (regarding architecture and landscape integration coherence). The final roof selection is made of roofs with homogeneous economic and grid-related qualities.

Table 3 - Summary of case study no 2.

Dynamics of assemblages (case study no 2)	Relational, continuous assemblage	Metric, discontinuous assemblage
Increase	To aggregate (#0) →	To granulate (#1) (#3)
		↓ ↑
Decrease		(#2)

5. Politics of the sun: local strategies of (re-)assembling materiality to manage discontinuity

Community-based solar projects are just getting off the ground in France. Although a few successful operations have been studied (Cointe 2014, 2015), most of them struggle because of a national solar policy that is based on high feed-in tariffs and the lack of regulatory framework at the local level. With respect to the French context, the two case studies considered in this paper are very original. They are embedded in a regional process whose aim is to foster alternative paths to develop solar energy with the help of groups of inhabitants and public authorities at the local level.

At the beginning of the paper, we posed three main questions related to the difficulties faced by the collective solar initiatives during their structuring, the innovative dimension of such cooperative developments compared with individualist investments in solar energy, and their capacity to encourage a commonisation of the solar resource, as well as new perspectives of energy justice. The analysis followed how different materialities (roofs, houses, grid electricity network and landscapes) have been brought together into specific assemblages to configure the access to the solar energy resource locally. A key outcome is that these emerging socio-technical systems are very unstable and subject to non-linear evolutions (increase, decrease) to which they have to adapt, with varying degrees of success. We draw four points of discussion from this analysis.

The first point of discussion relates to materiality and space, an aspect not often studied in the literature about managing shared resources (Ostrom 1990). Solar energy is a diffuse energy resource. On the Earth, it is spatially available from almost everywhere. Nevertheless, a ray of sunlight has to be concentrated in order to generate kilowatt-hours. This point focuses attention on the local material conditions as it may offer suitable configurations to channel a diffuse energy resource. Which spatialities would concentrate the sunlight? The development scheme initially envisioned by the regional Rhône-Alpes Energy Environment NGO was to colonise building's roofs in order to create solar plants at the scale of villages. This led to different approaches to materiality and space. The Pilat case looked at roofs in relation to buildings and their surroundings, which offered a view of roofs in terms of scales and relations (architecture, landscape). The aggregation of roofs was an operation that went beyond adding roof surfaces. It was a matter of creating a solar territory. By contrast, the Bauges case largely ignored the sun-related materialities. It reduced the roof to a sun intensity/surface ratio, and the territory to a matter of usual governance between rival municipalities. In the case of a diffuse energy resource such as solar energy, the "deposit" is not easily defined. In our case studies, it is collectively explored through various attempts to requalify diverse materialities (roof, building, area) to give them a shared (solar) existence in the project. Such an exploration of the buildings, the architecture and the landscape as sun-related materialities promotes a revision of the notion of "resource" beyond its usual categories. At first sight, the sun does not matter. It belongs to everybody and is not affected by individual use. The notions proposed in this paper (aggregation, granulation) focus on the emerging socio-technical assemblages progressively built up to turn the sun into an energy resource, as well as the spatial systems they generate.

This leads to the second point, namely the local strategies for assembling sun-related materialities. The initial question related to how an assemblage manages to grow and adapt to non-linear evolutions. Assemblage thinking usually insists on assembling things through either continuity (by relations/attention to heterogeneity) or discontinuity (by standardisation/homogeneity). In practice, the solar assemblages in this study cross over these categories. Thus, a new question may be: How do emerging assemblages strategically deal with discontinuity? In our fieldwork, discontinuity relates to various aspects: private interests (individual profitability), usual governance (compartmentalised space) and electric heritage (individual connectivity). Different strategies were used to this end, and here is a lesson from our study: The Pilat case study benefitted from an early relational appraisal of the landscape and architectural issues with respect to solar developments. This first solar assemblage did not resist the normativity of the grid expertise and its electric zoning but was strong enough to allow the project leaders to re-arrange its internal organisation in order to preserve its first qualitative ambition because other dimensions had not been subtracted. The ability to shift from one state of organisation to another was facilitated by the attention that had been paid to relations in the earlier steps of the process. This made it possible to detach roofs from the aggregate without pushing out their owners. These owners were still part of and interested in preserving a new balance between public and private roofs, panel exposure and architectural quality. Following the approach of Deleuze and Guattari, this assemblage may be re-organised at a lower intensity without losing the density of its attachments – and, thus, its collective spirit. In other words, this solar assemblage has maintained a relational potential for coherent growth in the future. By contrast, the Bauges case failed to create a concerned collective around the solar-related materialities and their issues. The solar project was discussed early on through tables that did not show an assemblage but myriad solar units to be added up. The grid expertise emphasised this trend and contributed to reducing individual roofs to a matter of electric production and profitability ("granulation"). This paved the way for competition and exclusive solar adventures and eventually led to an unmanageable process of subtracting the less profitable roofs. In other words, the first case managed discontinuity by detaching roofs without subtracting roof owners (so as to keep the cooperative dimension of the project alive) and kept the relational potential to collectively process and play with the electric grid; the second case failed to separate the two aspects of solar energy because a roof was accidentally also considered as an individual's roof and a surface to produce electricity.

The relations between private/individual materialities (roofs) and public/large infrastructures (electric grid) lead us to our third point, which concerns the politics of the sun in the making. Ostrom (1990) stresses the idea that the management of the commons constitutes a third way between having a publicly centralised authority regulating them and having economic agents regulate through the market. Our case study differs from the ones in this literature because the solar resource is inter- twined neither with management practices in the long run nor with highly institutionalised ones. The paper focuses on the setting up of collective frameworks to share the sun as an energy resource. Following sun-related materialities, from an individual building to a public electric grid, the paper makes visible the process of commonisation as a trial to be completed in the midst of both private and public issues. A continuum has to be invented that would allow the sun to pass from one side to another. As seen before, it is a matter of managing different types of discontinuities (individual profitability, as well as non-negotiable public infrastructure). From this point of view, the process of commonisation is not beyond private and public strategies but structures them around new materialities and issues. The notions that were envisioned (aggregation, granulation) to follow the gathering of roofs by local groups might receive further theoretical meaning if passages between different ways of seizing materialities were analysed (Table 4).

This approach offers a new understanding of the difficult development of France's solar policy. The development of small photovoltaic units was particularly invasive, especially when the tariffs were high and the regulatory framework was lacking, as was the case in France. Consequently, the individuals involved in solar projects used to be criticised for their opportunistic engagement mainly driven by high profitability. The current case studies stress the fact that these community-based solar pro- jects are not reducible to groups of private individuals. Some of them invent and test regulatory frameworks that are open to architecture and landscape-related issues. In a way, they experiment locally with what the state fails to work on at the national level: a sustainable approach to solar development, in the form of local gains, landscaping and a controlled rhythm of growth. These experiments call for resources underestimated by both the policymakers and the inhabitants in these groups. One resource this paper points to is the ability of a group to manage the increase and the decrease in an emerging assemblage to face economic and technical constraints. To pass from a higher level of organisation to a lower one (1 to 2) requires the capacity to revise key attachments (profitability, connectivity) without losing the project's collective dimension.

The fourth and final point of discussion relates to energy and environmental justice. At first glance, cooperative solar projects seem to initiate an inclusive approach of photovoltaic development. Through collective operations, everyone seems to be able to take part in photovoltaic projects, even if some people don't have a suitable roof for solar development or substantial capital. Thus, such collective adventures allow new actors to initiate or join energy transition actions and to access their economic outcomes. The collective management of such new local incomes might then foster the development of further energy transition–related actions at the local level (e.g. buildings' thermal refurbishing, other renewable energy projects), as planned by the public authorities we studied. However, this paper aims to go beyond merely how economic outcomes are distributed. Solar energy cooperatives might contribute in multiple ways to the construction of what Agyeman and colleagues call "just sustainabilities" (2003) by tackling issues of both sustainable development and energy/environment justice. More specifically, this paper underlines that the landscape lens appears to be an additional focus to discuss the issues of energy justice in the deployment of the energy transition. Our study has shown that the solar community's attempts to develop projects that are not fuelled only by economic factors include qualities that the feed-in-tariff scheme does not consider valuable. Their goal is to contribute not only to the emergence of new solar energy landscapes but also to the emergence of landscapes of justice (Mitchell 2003) resulting from a more-than- economic collective and concerted process. This reasoning is based on the way the collectives look at the materiality beyond a productive asset. In the case of Pilat, roofs were relationally considered as architectural and landscape components and not reduced to surfaces and potential objects of economic profitability. It became easier for the local group to modulate its collective organisation and face uncertainty. Thus, the fair solar energy project is not the one that only fairly distributes the benefits among the stakeholders but the one that can maintain enlarged collective qualities. In this case, an in-land "law" of justice means taking care of both the people engaged in a collective project and their attachments to a changing landscape by aggregating/detaching roofs without splitting up the group and its ambitions for a qualitative landscape. In this way, by trying to regulate the feed-in-tariff scheme, these collective solar initiatives try to play a role that neither the state nor the market plays. Their action does not apply to a modification of the scheme itself, but they try to work with the profitability that this scheme creates and add new qualities to what it might produce.

The creation of new energy commons leads to fragile processes underpinned by non-linear evolutions. These processes are susceptible to drifting in different directions, from commonisation to privatisation, even if the initial perspective centres on the development of alternative renewable energy ways. While many emerging collective assemblages decrease and sometimes split up, these processes will not systematically lead to a process of decommonisation. For this reason, only a few cases show the ability of a group to manage its internal and external relations strategically in order to increase resource accessibility.

Table 4 - Moving between materialities and their normativities: How to make the sun circulate from the roof to the grid.

How to make the sun circulate ?	*from the roof*, (individual materiality, private interest)	Passage?	*to the grid*, (public infrastructure, electric management)
Pilat case (no 1)	Relational and multi-scalar appraisal of the sun-related materialities (roof, building, area) makes it possible:	(1) to "aggregate" them around a shared solar perspective (2) to "detach" roofs without excluding individuals	(1) to envision quantitative solar potentials, albeit not entirely connectable to the grid (2) to modulate the project's connectivity to the grid and preserve a collective dimension
Bauges case (no 2)	Roofs listed as individual units and not distinguished from their private ownership makes it possible:	(1) to "granulate" the roofs around standardised solar qualities (2) to "subtract" the less profitable roofs to maintain a high profitability (failure)	(1) to envision quantitative solar potentials, albeit not entirely connectable to the grid (2) to split up the collective to allow individual profitable projects

Notes

1. See the papers from Meritet (2007) and Andriosopoulos and Silvestre (2017) for more on this point.
2. The same remark applies to other renewable energies such as wind power or micro hydro-electric plants.
3. The recent Ecological Transition for Green Growth Law (2015) initiated momentum towards loosening the conditions for participative funding (by citizens and local communities) of renewable energy production projects. However, this law did not lead to a significant change in renewable energy policies with regard to the community-based dimension of the projects.
4. According to the Institut National de la Statistique et des Etudes Economiques (INSEE) in 2013.
5. As a result, our description of the local political context is very limited; instead, we focus on the tools and methodologies used by the developers.
6. According to the Institut National de la Statistique et des Etudes Economiques (INSEE) in 2013.
7. As a result, our description of the local political context is very limited; instead, we focus on the tools and methodologies used by the developers as in the previous case study.

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References

Agyeman, Julian, Robert D. Bullard, and Bob Evans. 2003. Just Sustainabilities, Development in an Unequal World. London: Earthscan.

Aitken, Mhairi. 2010. "Wind Power and Community Benefits: Challenges and Opportunities." Energy Policy 38 (10): 6066– 6075. doi:10.1016/j.enpol.2010.05.062.

Allan, Grant, Peter Mcgregor, and Kim Swales. 2011. "The Importance of Revenue Sharing for the Local Economic Impacts of a Renewable Energy Project: A Social Accounting Matrix Approach." Regional Studies 45 (9): 1171–1186. doi:10.1080/00343404.2010.497132.

Andriosopoulos, Kostas, and Stephan Silvestre. 2017. "French Energy Policy: A Gradual Transition." Energy Policy 106: 376– 381. doi:10.1016/j.enpol.2017.04.015.

Baker, Tom, and Pauline McGuirk. 2016. "Assemblage Thinking as Methodology: Commitments and Practices for Critical Policy Research." Territory, Politics, Governance 26: 1–18. doi:10.1080/21622671.2016.1231631.

Bridge, Gavin. 2010. "Resource Geographies I: Making Carbon Economies Old and New." Progress Report 35 (6): 820–834.

Catney, Philip, Sherilyn MacGregor, Andrew Dobson, Sarah Marie Hall, Sarah Royston, Zoe Robinson, Mark Ormerod, and Simon Ross. 2014. "Big Society, Little Justice? Community Renewable Energy and the Politics of Localism." Local Environment 19 (7): 715–730. doi:10.1080/13549839.2013.792044.

Cointe, Béatrice. 2014. The Emergence of Photovoltaics in France in the Light of Feed-in Tariffs: Exploring the Markets and Politics of a Modular Technology. EHESS. https://tel.archives-ouvertes.fr/tel-01096977/.

Cointe, Béatrice. 2015. "From a Promise to a Problem: The Political Economy of Solar Photovoltaics in France." Energy Research & Social Science 8: 151–161. doi:10.1016/j.erss.2015.05.009.

Cowell, Richard, Gill Bristow, and Max Munday. 2011. "Acceptance, Acceptability and Environmental Justice: The Role of Community Benefits in Wind Energy Development." Journal of Environmental Planning and Management 54 (4): 539– 557. doi:10.1080/09640568.2010.521047.

Dardot, Pierre, and Christian Laval. 2015. Commun: essai sur la révolution au XXIe siècle. Paris: La Découverte.

Debaise, Didier. 2006. Un empirisme spéculatif: lecture de "Procès et réalité" de Whitehead. Paris: J. Vrin.

DeLanda, M. 2006. A New Philosophy of Society: Assemblage Theory and Social Complexity. A&C Black.

Deleuze, Gilles, and Félix Guattari. 1987. A Thousand Plateaus: Capitalism and Schizophrenia. Minneapolis: University of Minnesota Press.

Deleuze, Gilles, and Claire Parnet. 1996. Dialogues. Paris: Flammarion.

Devisse, Jean-Stéphane, Olivier Gilbert, and Fabien Reix. 2016. Quelle Intégration Territoriale Des Énergies Renouvelables Participatives? ADEME. http://www.ademe.fr/sites/default/files/assets/documents/quelle-integration-territoriale-enr-participatives-2016-rapport.pdf.

Dóci, Gabriella, Eleftheria Vasileiadou, and Arthur C. Petersen. 2015. "Exploring the Transition Potential of Renewable Energy Communities." Futures 66: 85–95. doi:10.1016/j.futures.2015.01.002.

Gomart, Emilie, and Antoine Hennion. 1999. "A Sociology of Attachment: Music Amateurs, Drug Users." The Sociological Review 47 (S1): 220–247.

Jenkins, Kirsten, Darren McCauley, Raphael Heffron, Hannes Stephan, and Robert Rehner. 2016. "Energy Justice: A Conceptual Review." Energy Research & Social Science 11: 174–182. doi:10.1016/j.erss.2015.10.004.

Kaup, Brent. 2008. "Negotiating Through Nature: The Resistant Materiality and Materiality of Resistance in Bolivia's Natural Gas Sector." Geoforum; Journal of Physical, Human, and Regional Geosciences 39: 1734–1742.

Labussière, Olivier, and Alain Nadaï. 2018. Energy Transition: A Sociotechnical Inquiry. London: Palgrave.

Latour, Bruno. 2000. "Factures/Fractures. De La Notion de Réseau À Celle D'attachement." In Ce Qui Nous Relie, André Micoud et Michel Peroni, dir., La Tour d'Aigues, Editions de l'Aube, 189–208. http://bruno-latour.fr/sites/default/files/ 76-FAKTURA-FR.pdf.

Meritet, Sophie. 2007. "French Perspectives in the Emerging European Union Energy Policy." Energy Policy 35 (10): 4767– 4771. doi:10.1016/j.enpol.2007.04.010.

Mitchell, Don. 2003. "Cultural Landscapes: Just Landscape or Landscape of Justice?" Progress in Human Geography 27 (6): 787–796.

Mitchell, Timothy. 2011. Carbon Democracy: Political Power in the Age of Oil. London: Verso.

Moss, Timothy, Sören Becker, and Matthias Naumann. 2014. "Whose Energy Transition Is It, Anyway? Organisation and Ownership of the Energiewende in Villages, Cities and Regions." Local Environment, 1–17. doi:10.1080/13549839.2014.915799.

Müller, Martin, and Carolin Schurr. 2016. "Assemblage Thinking and Actor-Network Theory: Conjunctions, Disjunctions, Cross-Fertilisations." Transactions of the Institute of British Geographers 41 (3): 217–229. doi:10.1111/tran.12117.

Nadaï, Alain, Olivier Labussière, Ariane Debourdeau, Yannick Régnier, Béatrice Cointe, and Laure Dobigny. 2015. "French Policy Localism: Surfing on 'Positive Energie Territories' (Tepos)." Energy Policy 78: 281–291. doi:10.1016/j.enpol.2014.12.005.

Nayak, Prateep Kumar, and Fikret Berkes. 2011. "Commonisation and Decommonisation: Understanding the Processes of Change in the Chilika Lagoon, India." Conservation and Society 9 (2): 12.

Olwig, K. R. 2002. Landscape Nature and the Body Politic: From Britain's Renaissance to America's New World. Madison: University of Wisconsin Press.

Olwig, K. R., and D. Mitchell. 2007. "Justice, Power and the Political Landscape: From American Space to the European Landscape Convention." Landscape Research 32 (5): 525–531. doi:10.1080/01426390701552688.

Ostrom, Elinor. 1990. Governing the Commons: The Evolution of Institutions for Collective Action. Cambridge: Cambridge University Press.

Poize, Noémie. 2015. "Etude du cadre législatif et réglementaire applicable au financement participatif des énergies renouvelables." Etude réalisée pour le compte de l'ADEME par RAEE.

Poize, Noémie, and Andreas Rüdinger. 2014. Projets citoyens pour la production d'énergie renouvelable, comparaison France-Allemagne. IDDRI-RAEE. http://www.iddri.org/publications/collections/idees-pour-le-debat/WP0114_NP%20AR_projets%20citoyens.pdf.

Simondon, Gilbert, and Jacques Garelli. 1995. L'individu et sa genèse physico-biologique. Grenoble: J. Millon.

Simondon, Gilbert. [1958] 2012. Du mode d'existence des objets techniques. Paris: Aubier.

Unruh, Gregory C. 2000. "Understanding Carbon Lock-in." Energy Policy 28: 817–830.

Unruh, Gregory C. 2002. "Escaping Carbon Lock-In." Energy Policy 30 (4): 317–325.

Walker, Gordon. 2008. "What Are the Barriers and Incentives for Community-Owned Means of Energy Production and Use?" Energy Policy 36 (12): 4401–4405. doi:10.1016/j.enpol.2008.09.032.

Walker, Gordon, Patrick Devine-Wright, Sue Hunter, Helen High, and Bob Evans. 2010. "Trust and Community: Exploring the Meanings, Contexts and Dynamics of Community Renewable Energy." Energy Policy 38 (6): 2655–2663. doi:10.1016/j.enpol.2009.05.055.

Yalçın-Riollet, Melike, Isabelle Garabuau-Moussaoui, and Mathilde Szuba. 2014. "Energy Autonomy in Le Mené: A French Case of Grassroots Innovation." Energy Policy 69: 347–355. doi:10.1016/j.enpol.2014.02.016.