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Large-scale photovoltaics? Yes please, but not like this! Insights on different perspectives underlying the trade-off between land use and renewable electricity development

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ABSTRACT

The need to reduce greenhouse gas emissions in the electricity sector requires an increase in renewable generation capacity. However, the necessary space for power generation infrastructure can be in conflict with other uses of available land and different perspectives on how the development of renewable electricity should occur can lead to stakeholder oppositions. In an explorative study, I used Q methodology to inquire how affected stakeholders perceived the development of a photovoltaic solar park in Switzerland. This allowed me to identify possible ways to alleviate conflicts between designating land for agricultural use and renewable electricity development. The results show that while most identified worldviews among stakeholders agreed large roof surfaces should be prioritized for solar panels, remaining divergences explain tensions that threatened the realization of the solar park. Two perspectives were in conflict: on one side, actors defending a strict protection of agricultural land; on the other, actors who considered it appropriate to build solar panels on fields. The results also suggest that renewable energy expansion should preserve a balance between large-scale and small-scale photovoltaic power development to be socially acceptable amongst a broad spectrum of stakeholders.

1. Introduction

As electricity production is a substantial driver of climate change, many countries have set roadmaps and policies to massively expand their share of renewable electricity in coming decades (EC, 2011; Lilliestam et al., 2014). In addition to this trend toward climate-friendly electricity production, several countries have decided to gradually phase out nuclear power plants (BFE, 2013; IEA, 2013a, 2013b), leading to an even greater need for renewable electricity. However, the different actors involved in energy transformation do not always agree on the ways to achieve a fully renewable electricity system, and they can support very different, sometimes contradictory, policy alternatives to achieve this goal (Díaz et al., 2017; Lilliestam and Hanger, 2016). This division can lead to delays in the construction of a sustainable energy system, putting climate change mitigation targets at risk.

The massive development of electricity-related infrastructure puts stress on available land (Huber et al., 2017; Turney and Fthenakis, 2011), and when conflicts between renewable electricity development and land use arise, different stakeholder perspectives on these issues can both enrich, yet also sour the debates (Díaz et al., 2017; Ellis et al., 2007; Wolsink and Breukers, 2010). While there is already extensive research ongoing on the environmental effects of renewable electricity infrastructure and competing land use (Brown et al., 2015; Huber et al., 2017; Wolsink, 2018), we know relatively little about the full spectrum of different stakeholder views surrounding the use of land for large, surface-impacting solar parks. An example of the tension between land use and large-scale photovoltaic power development is the *Boverie* photovoltaic solar park in Payerne, Switzerland. The project, a result of incentives to develop renewable electricity, came into conflict with environmental protection actors, mainly due to diverging perspectives on land use (Galliker, 2014). While the conflict between the two opposing parties was highlighted in the media, there are potentially more perspectives to consider than those publicized about the development of large-scale photovoltaic energy. In this explorative study, I address following research question: What different perspectives do stakeholders have on the development of on-field solar parks, more specifically the Boverie solar park? Additionally to this explorative question, I also address an additional research question to clarify the observed conflict during the planning of the power plant: Which stakeholder perspectives can generate opposition to on-field solar energy

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development? Answering these two research questions can provide relevant insights for the planning of future on-field solar parks.

Most of the existing research on social aspects of electricity-related infrastructure does not focus on facilities that require a large and concentrated amount of ground surface, but rather on either linear or scattered infrastructure like wind turbines and electricity transmission lines (Devine-Wright, 2013; Devine-Wright and Howes, 2010; Ellis et al., 2007; Wolsink and Breukers, 2010). There are attempts to examine the visual impact of solar parks (Chiabrando et al., 2009; Fernandez-Jimenez et al., 2015) and what people can consider as a reasonable distance that planners should take into account when planning solar power facilities on the ground (Brewer et al., 2015; Carlisle et al., 2016), but these attempts remain relatively of technical nature. Aiming to go beyond the approach focusing on the visibility of solar power facilities in technical terms, Wolsink (2018) emphasizes that the visual impact of solar power plants is not sufficient to accurately evaluate the impact from a stakeholder perspective. He claims that the impact of a solar power facility is subjective and can only be assessed by including how affected people see the planned infrastructure (see also Lothian, 1999). However, Wolsink (2018) did not empirically inquire on how the subjects, in this case citizens and stakeholders, view on-field solar power development. Therefore, in this paper, I aim to complement this body of research by investigating the different perspectives that exist among actors affected by a surface-intensive power facility, in our case a solar park.

To carry out this explorative study, I used Q methodology (Stephenson, 1953) to highlight the different actors' perspectives on large-scale solar power plants. I employed this methodology because it can be used according to two rationales (Watts and Stenner, 2012): first, to discover the different views of the actors involved in the process, and second, to better understand the subject, in our case the clash between renewable energy development policies and land preservation policies. In the past, Q methodology has been used to highlight different stakeholder perspectives in many fields like water management (Raadgever et al., 2008; Webler et al., 2003) and to understand different perceptions on overarching concepts like sustainable use of resources (Curry et al., 2013) or ecosystem services (Hermelingmeier and Nicholas, 2017). This methodology has also been used to highlight the usually broad spectrum of different actors' views surrounding renewable energy issues, like acceptance of hydropower plants (Díaz et al., 2017), the siting of wind turbines or electrical transmission lines (Cotton and Devine-Wright, 2011; Ellis et al., 2007; Wolsink and Breukers, 2010), and developing biomass energy (Cuppen et al., 2010). Additionally to highlighting the different views that stakeholders may have on solar parks, I also emphasize their points of consensus to identify possible ways to soften conflicts between land use and renewable electricity development. In this paper, I first present the case of the Boverie solar park. I then present and discuss the results of the study using Q methodology, highlighting their implications for energy and land use development in Switzerland.

2. Background – The Boverie solar park in Payerne

Following the Fukushima nuclear disaster in 2011, the Swiss government decided to phase out nuclear energy at the end of the life of the Swiss nuclear plants (BFE, 2013). To compensate for the loss of power generation capacity from this phase out—about one third of the produced electricity—the government aims to fill the gap through a massive development of renewable electricity capacity, mainly through solar and wind production (BFE, 2013, 2016). To reach these goals, the main policy measure to date has been feed-in-tariffs (BFE, 2017; Lilliestam et al., 2014). Since its implementation, this policy has generated an increased interest from many actors to develop renewable energy projects (Díaz et al., 2017; Lilliestam et al., 2014; Swissolar, 2017), and it not only applied to individual citizens, but also to companies developing larger projects.

In addition to the Swiss government's aim to develop renewable energy sources, large areas have been devoted to low-density residential areas as a result of relatively permissive regulations regarding land use, which has led to a rapidly expanding footprint of settlements and infrastructure (Nicole, 2013). To preserve agricultural land, the Swiss government set a cap in the development of built areas, which was accepted by the people through a referendum in 2013 (ARE, 2014). In its latest revision, the *Raumplanungsgesetz* (RPG)—the federal legal framework regulating land use development—requires that any newly developed agricultural space should be compensated for by dismantling other existing infrastructure (ARE, 2014). However, this legal framework sometimes comes into conflict with other policies designed to increase renewable energy capacity, especially when some infrastructure has a large impact on land, like solar parks (Abegg et al., 2012).

The municipality of Payerne aimed to generate the equivalent of its entire electrical consumption through renewable energy sources, mainly solar (Commune de Payerne, 2013). To reach this goal, the municipality developed the *Solarpayerne* project to massively develop its solar power capacity. The expansion of solar photovoltaic capacity started with larger roofs on municipal buildings and through an information campaign spread to the population who were encouraged to invest in solar plants for the roofs of their houses (Commune de Payerne, 2017). In the municipality, there was also an industrial zone called *La Boverie* that had never been developed (60,000 m^2); yet still used for agriculture. Considering this 'industrially unused' area, the local electricity company, under the impulsion of one citizen, developed the idea of a solar park filling this zone. La Boverie would be a solar park with about 40,000 m^2 of photovoltaic-panels, owned by the local electricity company, generating the equivalent of about 40% of the electrical consumption of Payerne (Greenwatt, 2013; Grenon, 2016).

To establish a participative process (see Rau et al., 2012) for the realization of the Boverie solar plant, the municipality, the local electricity company and the initiator of the project involved several actors and non-governmental organizations (NGOs) usually consulted in the planning processes for land impacting projects (Henchoz and Moullet, 2013). To build infrastructure at a municipal level in Switzerland, the planning process entails two main formal steps where stakeholder-input can be filed. In the first public inquiry, people can file written oppositions (Bovay et al., 2010). After this step, the proponents of the project can carry out modifications and present a revised version to satisfy opposing voices. Following these modifications, potential opponents can appeal to the district court. The conflict can be escalated toward higher levels in case of persisting disagreement: the cantonal and federal courts (FCh, 2017). Although conflicts related to infrastructure development are usually solved at a local level, opposition groups sometimes escalate the conflict to the federal level (Lambiel, 2016). In the case of the Boverie solar plant, one NGO made a formal opposition to the solar park during the development of the project, arguing that it was an inappropriate use of land. Even though the industrial zone was not yet developed and was still dedicated to agriculture, the municipality would have to compensate for its future urban development due to the RPG (Galliker, 2014). The proponents of the project argued that the land intended for the solar park was already zoned as industrial land and could therefore be used for electricity-generation purposes (Greenwatt, 2013), securing the use of the land and avoiding its return as an agricultural zone. Following the opposition, the proponents did not substantially change the project, but the NGO making opposition chose not to litigate, estimating that their chances to succeed in avoiding the construction of the plant were too little. The power plant was eventually put in operation in 2015 (Grenon, 2015).

Although the solar park in Payerne was eventually built, its planning process did not work smoothly. Additionally, we can expect the tension between land use and energy strategy found in Payerne to appear more frequently in the future, as the Swiss energy strategy requires