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Local acceptance of existing biogas plants in Switzerland

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HIGHLIGHTS

- Acceptance of biogas plants by local residents in Switzerland is relatively high.
- Local acceptance is highly affected by perceived outcomes and citizens' trust.
- Smell perception increases perceived costs and reduces perceived benefits and trust.
- Information offers reduce perceived costs and increase trust and perceived benefits.
- Participation offers do not have any effect on local acceptance.

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ABSTRACT

After the Swiss government's decision to decommission its five nuclear power plants by 2035, energy production from wind, biomass, biogas and photovoltaic is expected to increase significantly. Due to its many aspects of a direct democracy, high levels of public acceptance are necessary if a substantial increase in new renewable energy power plants is to be achieved in Switzerland. A survey of 502 citizens living near 19 biogas plants was conducted as the basis for using structural equation modeling to measure the effects of perceived benefits, perceived costs, trust towards the plant operator, perceived smell, information received and participation options on citizens' acceptance of "their" biogas plant. Results show that local acceptance towards existing biogas power plants is relatively high in Switzerland. Perceived benefits and costs as well as trust towards the plant operator are highly correlated and have a significant effect on local acceptance. While smell perception and information received had a significant effect on local acceptance as well, no such effect was found for participation options. Reasons for the non-impact of participation options on local acceptance are discussed, and pathways for future research are presented.

1. Renewable energies in Switzerland

In Switzerland people differentiate between renewable energies and *new* renewable energies. The former is synonymous with hydropower, which has played an important role in the Swiss energy landscape for a long time. In 2010, hydropower already accounted for 56.5% (approx. 37,500 GW h) of Swiss total electricity production (Bundesamt für Energie BFE, 2010a). The latter stands for renewable energy sources such as wind, biomass, biogas and photovoltaic. New renewable energies have not played a major role in Switzerland so far: in 2010, electricity production from new renewable energies amounted only to 2.1% (approx. 1400 GW h) of Swiss total electricity production. Of this, approximately 6.2% (87 GW h) was produced in biogas facilities (Bundesamt für Energie BFE, 2010b).

In the next decade, a significant increase in new renewables energies is expected, as described in the concept paper "Energie Schweiz 2011–2020" (Bundesamt für Energie BFE, 2010c). The importance of such a development is intensified by the Swiss Government's decision in May 2011 to decommission its five nuclear power plants by 2035. This amounts to a reduction by approximately 26,100 GW h, or 38.1% of Swiss total electricity production. In April 2012 the Swiss Federal Council announced its plan to compensate the emerging gap with up to six new-built gas-fired power plants. However, the ensuing discussion in Swiss public media indicates a lack of support for this plan on the part of important stakeholders and the Swiss population in general. It seems evident that new renewable energies will have to play their part in making up for the Swiss abandoning nuclear energy.

High levels of public acceptance are necessary if a substantial increase in new renewable energy power plants is to be achieved in Switzerland. The Swiss political system encompasses many aspects

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of a direct democracy: citizens can vote directly on many political issues and can raise objections at the federal, cantonal or communal level during the planning process. This leads more often than not to the different levels paralyzing each other rather than working together effectively. The Swiss government is aware of this issue: one of the first planned measures to facilitate the increase of new renewable energy production is a simplification and standardization of planning procedures (Bundesamt für Energie BFE, 2012). Although a referendum pro/contra specific renewable energy projects is not the rule, it is almost impossible to build new renewable-energy power plants without providing local residents any opportunities for dialog (Geissmann and Huber, 2011).

So far, only minor research efforts have been made in Switzerland focusing on public acceptance of renewable energy plants at the local level. One Swiss work group of the international energy agency (IEA) has been founded to research the social acceptance of wind energy and to ensure international cooperation in this growing field of research (http://www.socialacceptance.ch). However, it is not known how citizens living around renewable energy plants feel about these infrastructure projects and what factors are relevant for public acceptance at the local level in the long term. Such knowledge is vital to mastering the planned expansion of new renewable energy production with a minimum of citizens' opposition. Research focusing on factors influencing the local acceptance of biogas plants appears to be especially promising. Apart from small-scale photovoltaic plants, biogas plants are the most numerous of new renewable energy plants in Switzerland. According to the Swiss federal office of energy (BFE), there were 117 biogas plants operating in Switzerland in 2010 (Bundesamt für Energie BFE, 2010b); of these, 72 were agricultural, 23 were commercial–industrial, and 22 were industrial sewage or co-fermentation in wastewater treatment plants (Bundesamt für Energie BFE, 2010b). These plants differ in terms of processed substrates, plant size and produced outputs. The research project presented in this paper focuses particularly on agricultural biogas plants already in operation, mainly in order to achieve high comparability of plant and development characteristics in the sample. Furthermore, local acceptance is highly relevant for agricultural biogas plants because they are often located near residential areas.

Biogas plants produce heat, electricity and/or fuel. In 2010, the 72 agricultural biogas plants in Switzerland produced about 46 GW h electricity, 10 GW h heat and 7 GW h fuel (Bundesamt für Energie BFE, 2010b). Feedstock used were animal substrates, such as paunch content, pig manure or chicken dung, as well as substrates from food, e.g. coffee grounds or maltodextrin and biological substrates as lawn cut are processed (Bundesamt für Energie BFE, 2010b). Operators of Swiss agricultural biogas plants are mainly private individuals, especially farmers. Produced electricity is reimbursed through a feed-in tariff. Local marketing of the produced electricity is therefore not possible.

A survey of citizens living in the proximity of existing agricultural biogas plants focusing on public acceptance would provide sufficient data to infer how new renewable energies are perceived at the local level, as done with the research presented in this paper.

2. Theoretical concepts regarding public acceptance

Research into public acceptance of renewable energy projects (REPs) has been conducted around the world by various disciplines. A prominent focus of these research activities is the NIMBY metaphor ("Not in my backyard") (e.g. Bell et al., 2005; Van der Horst, 2007; Warren et al., 2005; Wolsink, 2000). NIMBY is understood as an element of rational-choice theory which states that human behavior is motivated mainly by self-interest (Hunter and Leyden, 1995). In the context of REPs, rational choice theory implies that citizens only support renewable energy developments if they are not built in their backyard. Empirical evidence suggests that this supposition is inadequate (Wolsink, 2000), leading to researchers' criticizing the NIMBY explanation due to its unidimensional approach (Devine-Wright, 2009; Rau et al., 2011). Various researchers have emphasized the importance of applying more differentiated theoretical concepts in researching local acceptance of REPs (Burningham, 2000, p. 55; Devine-Wright and Howes, 2010, p. 8; Warren et al., 2005, p. 853; Wolsink, 2000, p. 57).

One promising alternative theoretical concept is justice theory. Distributive and procedural justice theory has already been successfully used in researching public acceptance of REPs, resulting in new insights into how such projects are perceived by citizens at the local level (Gross, 2007; Zoellner et al., 2008; Walter and Gutscher, 2010). Justice theory allows a multidimensional perspective, focusing on both perceived costs and benefits of such facilities as well as relevant characteristics of the planning process. Thus, this study also uses justice theory as its theoretical framework. In the following, we give a short overview of distributive and procedural justice theory and describe how they can be applied to research into public acceptance of biogas plants.

From a socio-psychological perspective, distributive justice theories are rooted in Adams' equity theory (Adams, 1965). They explain when outcome distributions of specific resources (e.g. money, information, goods and services, but also insults, hatred and misinformation) are perceived to be fair and when they are not. The degree of perceived outcome fairness influences a number of additional variables, including outcome acceptance and legitimacy. When it comes to local acceptance of REPs, researchers place a focus on costs and benefits as perceived by local residents. In this context, costs and benefits are not only considered in their monetary dimension but can encompass a wide range of topics: on the benefits side there are, for example, creation of local employment, climate protection, tourist attractiveness, community improvement and reduced energy costs (Devine-Wright, 2007; Upreti, 2004; Zoellner et al., 2008; Walter and Gutscher, 2010). In terms of costs, the following examples are evident in the literature: unpleasant smells, adverse impacts on the landscape, constraints on quality of life, and various economic costs, such as reduced property prices and adverse effects on tourism (Devine-Wright, 2007; Upreti, 2004; Upreti and Van der Horst, 2004; Walter and Gutscher, 2010; Zoellner et al., 2008).

Procedural justice theories can be grouped into structural models and relational models. While structural models focus on how structural procedure characteristics influence perceived justice, relational models focus on characteristics and behavior of authorities which are seen as being relevant for stable long-term relationships between them and citizens or subordinates.

Regarding structural models, in their study about perceived fairness in trial proceedings Thibaut and Walker (1975) found that the distribution of process control and decision control accounted for differences in perceived justice. Process control was defined as a disputant's control over the presentation of evidence and decision control as a disputant's control over the actual decision made. Using an applied perspective, it is deemed practical to differentiate between participation and information offers (e.g. Jobert et al., 2007), and to assess the quantity, quality and timing of these offers. The quality of information and participation offers in the context of REPs is assessed twofold: first, the objectiveness and truthfulness of the information provided are deemed relevant (e.g. Gross, 2007; Walter and Gutscher, 2010). Second, information is assessed as to whether it is matched to citizens' level of knowledge and whether their main concerns are addressed (Cass and Walker, 2009; Walter and Gutscher, 2010). In addition, the