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# Renewable Energy, Authenticity, and Tourism: Social Acceptance of Photovoltaic Installations in a Swiss Alpine Region

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With the increasing emergence of renewable energy sites in Switzerland, new impacts on the landscape can be observed. Above the Alpine village of Bellwald, a pilot project testing avalanche barriers as a possible site for

photovoltaic installations was inaugurated in 2012. This study focused on social aspects of the project and asked questions about local residents' and tourists' perceptions of and attitudes toward the installations. Its findings reveal that the

new elements are not perceived as a drastic intrusion into the landscape, because the view was already affected by the avalanche barriers, which are accepted because of their vital protective function. No significant difference was found between residents' and tourists' evaluation of the new photovoltaic installations. However, different factors influenced the perceptions of these 2 groups. In both groups, conceptions related to place played an important role in the evaluation of possible photovoltaic sites.

**Keywords:** Solar energy; social acceptance; landscape change; tourism; authenticity; place image; Switzerland.

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## Introduction

With the increasing emergence of renewable energy sites, new impacts on the landscape and scenery can be observed. In particular, high mountain photovoltaic sites are considered promising; their annual energy production is much higher than in low-altitude locations because they receive more direct and indirect radiation (Häberlin 2010). Therefore, changes in alpine scenery have to be expected in the future. This forms the basis for debates about local acceptance of new energy projects. Especially in the Swiss Alps, where tourism plays an important economic role, sensitivity regarding landscape changes tends to be higher, because the landscape is one of the most important elements of leisure and tourism attractions (Aitchison et al 2000).

While many recent research projects have emphasized wind energy (Jobert et al 2007; Devine-Wright and Howes 2010), solar energy sites have received less attention in the analysis of perception and acceptance, and research has focused on large-scale photovoltaic parks (Baggioni 2014). The tourism value of a location as a possible factor influencing the acceptance of photovoltaic sites has hardly been discussed. To fill this gap, this study focused on a solar energy project in the Swiss Alps to evaluate local residents' and tourists' perceptions of and attitudes toward photovoltaic installations in an alpine landscape.

Following Switzerland's decision to cease nuclear energy production in 2011, many regions promoted renewable energy technologies. Along these lines, the Goms Valley in the canton of Valais aims to establish itself by 2035 as an "energy region"—a model of sustainable, decentralized, and local energy production (EnergierregionGOMS 2012). To achieve this goal, local renewable energy initiatives are encouraged and supported by the association EnergierregionGOMS (Hallenbarter and Walther 2007).

In 2012, the pilot project Photovoltaic Installations on Avalanche Barriers was launched in the ski area of Bellwald. The goal of the pilot project is to evaluate the technical suitability and social acceptance of avalanche barriers as a site for solar panels. The avalanche barriers above the village of Bellwald were installed in the early 1980s following an avalanche that damaged a local restaurant (Graf and Buchecker 2012). Because the barriers are located on a south-facing slope and are close to existing infrastructure—primarily power lines for a chairlift and a snow-making system—the site was considered especially suitable for the installation of solar panels. The generated power is directly fed into the ski lifts' engines. The project is the first of its kind in Switzerland (Schmidhalter 2013). It consists of 2 subprojects based on 2 proposals to achieve the same goal using different technical methods. One subproject was

**FIGURE 1** Avalanche barriers with photovoltaic installations in the ski area near Bellwald. On the left side, the panels are installed individually; on the right side, also shown in the inset, the panels are connected. (Photos by Annina Michel)



initiated and financed by local residents, and students and volunteers from a nongovernmental organization helped construct the panels. A large part of the second subproject was financed by a Valaisian energy company, which worked with the association EnergieregionGOMS, the municipality of Bellwald, and the ski lift operator (Graf and Buchecker 2012). In general, local media reported positively on the pilot project after its inauguration (Anonymous 2012).

The installation is visible from afar and thus changes the appearance of the landscape (Figure 1; Swiss Federal Institute for Forest, Snow and Landscape Research 2013). Because the village of Bellwald depends on tourism (Willmann 2010), residents and tourists might react negatively to landscape changes. Therefore, the pilot project is concerned not only with technical aspects but also with social acceptance of the installations. This study thus focused on the opinions and perceptions of residents and tourists. The opinions of experts were

not considered, because the expert discourse on this project focuses mainly on technical issues. The study used quantitative methods and followed an earlier qualitative study (Graf and Buchecker 2012) to explore the following questions in relation to the Bellwald project site:

- How do residents and tourists perceive and evaluate photovoltaic installations on avalanche barriers?
- What factors influence these perceptions and attitudes?
- How does acceptance of avalanche barriers as sites for photovoltaic installations compare to acceptance of other photovoltaic sites?

### Theoretical background and hypotheses

Energy production and the expansion of renewable energy have had large-scale effects on landscapes in recent years. Often, the construction of new

infrastructure evokes strong opposition, although people may generally support a certain technology or livelihood (Soini et al 2011; Wolsink 2012). This opposition has often been called “not in my backyard” (NIMBY) thinking, yet recent studies have shown that attitudes toward renewable energy sites are complex and strongly affected by local considerations (Devine-Wright 2005; Jobert et al 2007; Wüstenhagen et al 2007; Zoellner et al 2008). A location near a tourism destination introduces additional complexity. Landscape changes have different effects on different stakeholder groups, such as residents and tourists, because the landscape is perceived in different ways (Fyhri et al 2009). In places that are perceived as nearly natural or as recreation areas, opposition to new infrastructure projects can be more pronounced (Devine-Wright and Howes 2010).

Such perceptions and attributions can also be described as *images*, which—in this case—are related to a certain place. Images usually originate from discourses and are spread and sustained through communication (Weichhart et al 2006). Hence, *place images* are often commonly shared (Walther 1988). Tourism marketing uses place images to attract more visitors and to emphasize a region’s uniqueness (Bramwell and Rawding 1996; Kokosalakis et al 2006). These images are by no means static; rather, they can shift, for example, during a first visit to a tourist area (Gunn 1972). This changeability is also found in economies not focused on tourism, because local resistance to or acceptance of a proposed energy site can be heavily influenced by place images (Jobert et al 2007; Zoellner et al 2008).

While place images are often collectively shared and economically used, place can also be conceived on a more individual, subjective level. This is composed of in the concept of *sense of place*, which is based on symbolic meanings attributed to the setting (Stedman 2003). People are more willing to fight for the conservation of places that are meaningful to them and threatened by change (Stedman 2002: 577). Along these lines, Vorkinn and Riese (2001) showed that place attachment can influence the opinion of local residents on new renewable energy projects. Concerning a hydropower project in Norway, “place attachment explained more of the variances in attitudes than the sociodemographic variables all together” (Vorkinn and Riese 2001: 249).

Symbolic meanings can also be found in the understanding of *authenticity*, a focus of this study. Osbaldiston (2011) reflects on authenticity in the context of amenity migration and discussed narratives and motivations that “underpin an individual’s desire to escape the city life within rural ... communities” (Osbaldiston 2011: 214). He shows “how the natural world is constructed in discourse to be pristine, untouched, and spectacular within regional places. Through these thoughts, landscapes are juxtaposed implicitly against the city as a dirty and aesthetically

unpleasing area” (Osbaldiston 2011: 223). Apart from the natural environment, social aspects might also play a role in the argumentation surrounding amenity migration. The lack of community sociality in the city is opposed to its (real or assumed) presence in rural places, where community is often more locally rooted. Osbaldiston (2011) resorts to the terms “profane” and “sacred” to characterize these differences. An analysis of authenticity as a driving factor can also be found in research projects concerning tourism. Kianicka and Buchecker (2007: 19), for example, showed that tourists assessed a planned construction project as appropriate as long as it corresponded to their vision of an authentic landscape. In a similar vein, Devine-Wright and Howes (2010) found that more opposition to new infrastructure appears in places that are perceived as nearly natural.

These concepts show that diverse constructions related to place can influence people’s reactions to landscape changes and therefore their attitudes toward new photovoltaic installations. We hypothesized that people’s image of the place, and in particular the anticipated positive impact of the project on the place image, would positively influence their attitude toward the photovoltaic installations on the avalanche barriers in Bellwald. Moreover, we hypothesized that people with a stronger bond to the place would perceive the new installations rather negatively (cf Vorkinn and Riese 2001; Devine-Wright and Howes 2010). The influence of these factors was expected to differ between residents and tourists.

## Methods

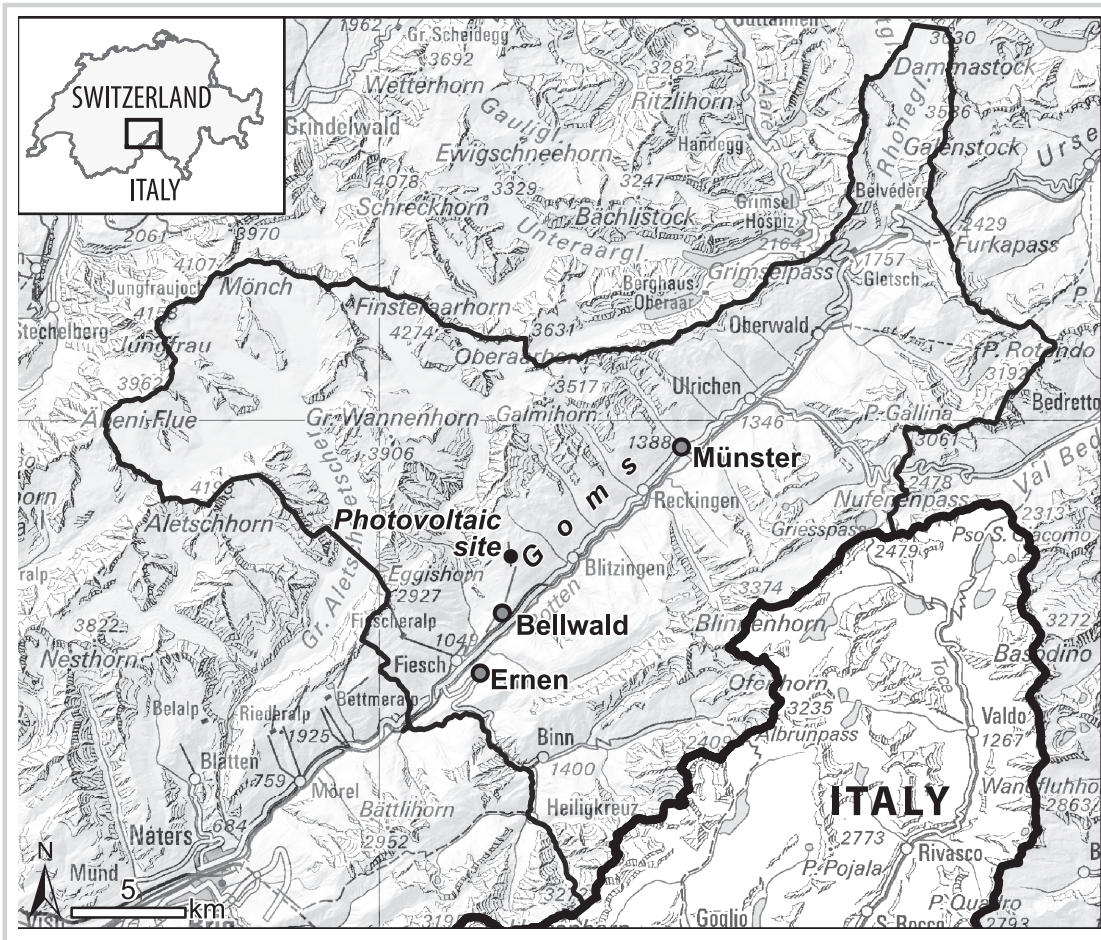
### Study area

The study was conducted in the uppermost part of the Rhône River basin, the Goms Valley, in the southern Swiss Alps (Figure 2). In this region, agriculture and tourism are the most important economic sectors (Willmann 2010). The pilot project is located in the skiing area near Bellwald (655’166.5, 144’146.1; CH1903/LV03), a village with a population of 438 situated on a sunny south-facing slope with an elevation of 1560 m above sea level (Federal Statistical Office 2013).

### Field survey

The study is based on a survey using standardized questionnaires, with most answers based on Likert scales. The survey was conducted in March and April 2013, before the first results on the project’s energy yield and cost effectiveness were discussed in the local media. Besides residents and tourists in Bellwald, the questionnaire was administered to residents of the neighboring municipality of Ernen (from which the project site is partially visible) and the more distant village of Münster (from which the site is not visible). Thus, the sample was extended, and additional analyses concerning the influence of distance and visibility was

**FIGURE 2** Map of the Goms region (1:50,000), showing the villages included in the survey, as well as the photovoltaic installation site. (Map courtesy of Swisstopo; additional information designed by Annina Michel)



made. For each of the 4 sample groups, the questionnaires were slightly adapted. In particular, the questionnaires addressing the tourists contained a few questions that were different from those for the 3 groups of residents. In the 3 villages, a household census, addressing residents older than 18, was conducted. Tourists were selected for participation based on an opportunistic sampling method (Patton 1990: 179): Questionnaires were displayed in hotels, and tourists were approached directly in their vacation homes and on paths. A total ( $N$ ) of 352 questionnaires were returned. The response rate in Bellwald was 39% ( $n = 82$ ), in Ernen was 31% ( $n = 102$ ), and in Münster was 29% ( $n = 93$ ). The percentage response rate for the tourist sample ( $n = 69$ ) could not be calculated, because some remaining questionnaires could not be retrieved.

The percentage of male participants in the surveys (Bellwald 74%, Ernen 72%, and Münster 56%) was higher than that of men living in the villages (54%, 49%, and 49%, respectively; Cantonal Office for Statistics and Financial Adjustment of Valais 2012). Furthermore, the

age group between 20 and 40 years was slightly underrepresented.

### Constructing the dependent variables

To determine how the participants perceived landscape change in terms of renewable energy use, respondents were shown photographs of the avalanche barriers with and without photovoltaic installations and asked about their perceptions of how these technical elements in the landscape were used. Although the evaluation of photographs cannot account for the actual perception of the landscape in situ, photographs used in surveys have proved useful for understanding people's perceptions and opinions on specific scenarios (Junker and Buchecker 2008; Soliva et al 2008; Fyhri et al 2009).

Survey participants were asked to describe their perceptions using 6-level bipolar rating scales, including items corresponding to concepts of authenticity (Kianicka and Buchecker 2007; Frick and Buchecker 2009). Kianicka and Buchecker (2007: 6) defined the term *authentic*, in relation to landscapes, as appropriate,

“in the sense that the surface of something ... corresponds with its ... inner core.” Items measuring the aesthetic dimension of authenticity, as well as the notion *give meaning to the place/desecrate the place*, which is derived from Osbaldiston’s (2011: 220) concept of sacred places, were also used. To identify possible discrepancies between the aesthetic perception of technical features in the landscape and their assumed utility, the item *useful/not useful* was added to the rating scales. According to Kianicka and Buchecker (2007), some local residents refer to the usefulness of infrastructure as a criterion for authenticity.

A factor analysis describing the variability revealed that all items of the respective questions load on 1 factor. The factor for the scenario without photovoltaic panels—avalanche barriers (AB)—explains 62.4% of total variance, with a Cronbach’s  $\alpha = 0.872$ . The factor consisting of the variables describing the perception of the avalanche barriers with photovoltaic panels—avalanche barriers solar (ABS)—explains 66.2% of the total variance ( $\alpha = 0.892$ ).

### Constructing the independent variables

Considering the independent variables, possible explanatory aspects were selected based on the preceding literature review. Because of the different sample features, some items differed across the respective questionnaires. Place image was addressed in 2 questions, 1 referring to perceptions of Bellwald or the Goms region and 1 referring to the assumed impact of the project on the place image. Sense of place was addressed in different items, partly based on existing scales (Kienast et al 2013), relating to personal feelings, as well as social and economic dependencies, associated with Bellwald or the Goms region.

The impact of transparency and the possibility of participating in a planning process on the acceptance of renewable energy projects by locals are well discussed in the social sciences (Devine-Wright et al 2001; Zoellner et al 2008). Therefore, items regarding people’s impressions of the planning phase of the pilot project and information received from the initiators were included.

Because the influence of the general attitude toward renewable energies on the locals’ support for a project is attested in the literature (Gross 2007; van der Horst 2007), questions on possible sites for the installation of solar panels were posed. To link these personal opinions to the concept of authenticity, the term *appropriate* was again used to describe possible facilities. All questions had to be answered by selecting a value on a 6-point Likert scale.

The details on construction of independent variables using factor and reliability analyses are given in the *Supplemental data*, Table S1 (<http://dx.doi.org/10.1659/MRD-JOURNAL-D-14-00111.S1>). In addition, socioeconomic

variables were included: gender (1 = female, 0 = male), employment (1 = employed, 0 = unemployed/retired/student), tertiary education (1 = yes, 0 = no), residence (1 = local resident, 0 = tourist), and age. Tourists were also asked how often they had visited the site (1 = more than 1 visit, 0 = first visit).

### Statistical analysis

Statistical analysis of the data was conducted using IBM SPSS 21 and Microsoft Excel. To ensure data validity, a series of descriptive and exploratory analyses were executed before calculating differences and causalities. The latter were tested with a multiple linear regression model (backward, listwise elimination).

## Results

### Perception of photovoltaic installations

Respondents (tourists and residents from all 3 towns) rated avalanche barriers with and without photovoltaic panels similarly (Figure 3). The perceivable slight differences are not significant, as exposed by a dependent *t*-test ( $t_{305} = 0.549, P > 0.05$ ). In general, these technical elements in the landscape were described as particularly appropriate and useful.

Analysis of variance revealed significant differences among the populations sampled ( $F_{3,309} = 5.566, P = 0.001$ ). The Tukey post hoc test revealed that the photovoltaic installations were significantly more positively perceived by Bellwald residents than by people living in Ernen ( $P = 0.005$ ). The same pattern appears in the comparison between tourists in Bellwald and those in Ernen ( $P = 0.008$ ).

### Factors influencing perception and acceptance

To identify the main influencing variables, backward elimination regressions were performed (Table 1). Preliminary correlation analyses calculated after Pearson showed that the 2 variables AB and ABS are highly correlated ( $r = 0.723, P < 0.01$ ). Hence, multicollinearity has to be assumed (Brosius 2011). This was also affirmed by the high  $\beta$  values of the independent variable AB calculated in the regression models for the response variable ABS. Following these findings, the regression analyses were conducted a second time excluding AB from the calculation.

For the complete data set, 2 explanatory variables most strongly predict the regressand: The anticipated influence of the project on the image of the region, *project place image* ( $\beta = 0.239, P < 0.01$ ), and the opinion on possible photovoltaic installations in Bellwald, *solar Bellwald* ( $\beta = 0.236, P < 0.01$ ). The variable *local residents vs. tourists* does not significantly influence the dependent variable and is therefore not shown in Table 1. Nevertheless, differences between residents’ and tourists’

FIGURE 3 Survey participants' opinions on the avalanche barriers alone (AB) and with photovoltaic installations (ABS).

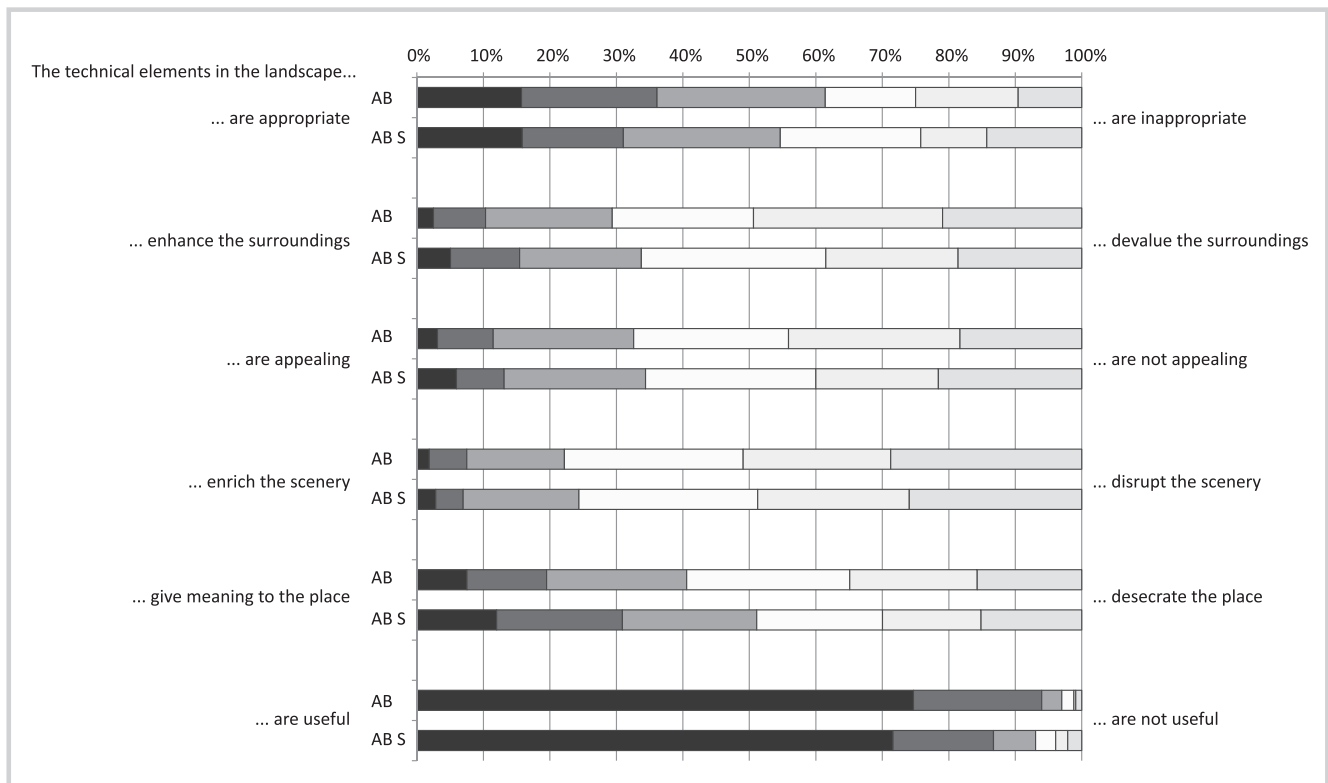


TABLE 1 Backward elimination regression with listwise deletion with the ABS dependent variable.

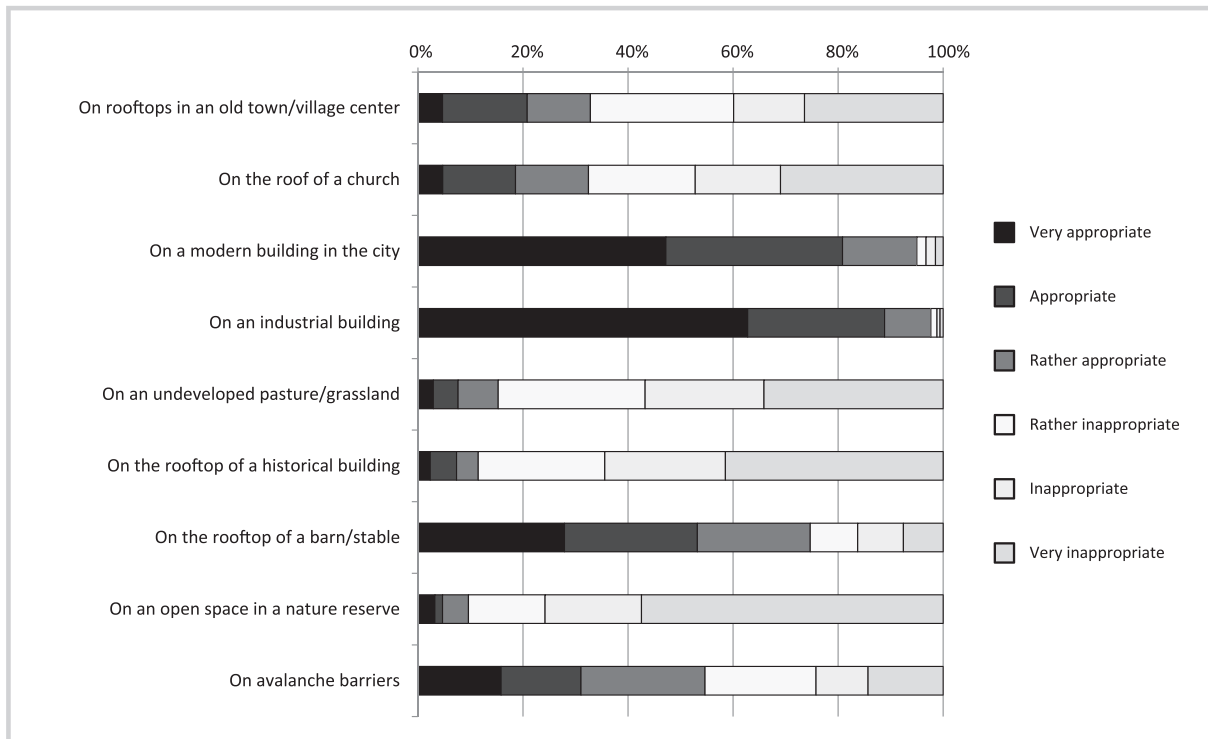
Variables	Standardized $\beta$ values		
	All respondents	Bellwald residents	Tourists
AB	(0.634** <sup>a</sup> )	(0.533**)	(0.631**)
Place image 2 ("modern")		-0.262*	
Project place image	0.239**	0.602**	
Project participation		0.317*	
Solar Bellwald	0.236**		0.409*
Solar industrial	0.136*	0.273*	
Number of visits			-0.685**
Gender	0.118*		
Employment	-0.159**		
Age		0.241*	
$R^2_{corr}$	0.306	0.598	0.308
F value	14.503**	12.886**	3.487*

<sup>a</sup>)  $\beta$  values in parentheses are derived from the first calculations including AB.

\* $P < 0.05$ .

\*\* $P < 0.01$ .

FIGURE 4 Survey participants' opinions on potential photovoltaic sites.



perceptions can be seen in the explanatory variables found in the subsample analyses.

For Bellwald residents, the anticipated influence of the project on Bellwald's image, *project place image*, is the strongest positive explanatory variable ( $\beta = 0.602$ ,  $P < 0.01$ ). Hence, people who expected the pilot project to have a positive effect on the place image rated the photograph showing the installations more positively. Participation in the project's planning process is another explanatory variable ( $\beta = 0.317$ ,  $P < 0.05$ ).

In the tourists' responses, the most important explanatory variable of ABS is the number of previous visits ( $\beta = -0.685$ ,  $P < 0.01$ ). Tourists who had visited Bellwald several times rated the picture of the project more negatively. Similar to the sample as a whole, the opinion on possible photovoltaic installations in Bellwald (*solar Bellwald*) appeared to be a strong predictor of the response variable ( $\beta = 0.409$ ,  $P < 0.05$ ).

#### Perception of different photovoltaic sites

Participants were also asked to rate their acceptance of several potential sites for photovoltaic installations, including on avalanche barriers. As Figure 4 shows, industrial sites and modern buildings were considered the most appropriate, followed by agricultural buildings and avalanche barriers. Sites on open agricultural land, in protected areas, and on historical buildings were,

however, rated critically. It thus can be generalized that sites on existing structures with a functional character were rated positively, while sites on buildings with symbolic meaning and on open lands were rated the most negatively.

Factor analysis affirmed the descriptive data, given that the items load on 3 factors: *solar village* ( $\alpha = 0.803$ ), including meaningful places; *solar industrial* ( $\alpha = 0.677$ ), referring to industrial, agricultural, and urban settings; and *solar field* ( $\alpha = 0.758$ ), referring to undeveloped grasslands and nature reserves. The differences among the means of these 3 factors were tested for significance using *t*-tests for dependent variables. The differences between *solar village* and *solar industrial* ( $F = -3.981$ ,  $P < 0.01$ ) and between *solar village* and *solar field* ( $F = 4.900$ ,  $P < 0.01$ ) are significant. Hence, solar panels on buildings without a symbolic meaning were rated significantly more positively than solar panels on meaningful buildings and open lands.

#### Discussion

Social acceptance of landscape changes is a major challenge for the expansion of renewable energy production. The main goal of this study was to evaluate residents' and tourists' perceptions of photovoltaic installations on different sites, with a focus on



installations on avalanche barriers, which are part of a recent pilot project in a Swiss mountain tourism resort in the Goms Valley.

Photovoltaic installations on avalanche barriers in Bellwald were well accepted by all categories of survey participants. We found no significant difference between the evaluations of the avalanche barrier site without and the evaluations of it with photovoltaic installations. Construction of the avalanche barriers is apparently seen as the main technical intervention in the landscape, and these are well accepted because of their vital protective function. Even if the structures gain another function, in this case energy production, the main purpose of the barriers is still the same, and the perception does not significantly alter.

Measuring acceptance based on different concepts of authenticity (cf Kianicka and Buchecker 2007; Osbaldiston 2011), as well as utility, allowed a more differentiated understanding of people's attitudes to technical interventions in natural settings. Avalanche barriers appeared to be perceived as slightly less appealing and meaningful, and slightly more useful, than the avalanche barriers additionally used for renewable energy production. Interestingly, in the case of the avalanche barrier sites, all acceptance items load on 1 factor. Usefulness and perceived authenticity seem, therefore, to be 2 dimensions of acceptance that can coincide if the interference with the natural setting is not thought of as substantial.

Despite the general support for the photovoltaic installations on the avalanche barriers, there appeared to be a slight but significant difference between the residents and tourists in the site village (Bellwald) and the residents in a neighboring village (Ernen), who have a partial and distant view on the site. There, acceptance of the installations is lower, which contradicts the basic idea of a NIMBY effect. The impact is perceived as lower than the benefit, and there seems to be an additional "backyard" benefit for the residents of Bellwald.

Regression analysis revealed different factors influencing acceptance of the photovoltaic site by Bellwald residents and tourists. In general, the basic attitude toward the photovoltaic technology did not appear to be a relevant predictor. Only the attitude toward photovoltaic installations in Bellwald was found to have a significant influence on the acceptance of the avalanche barrier site. However, this attitude is related to the place image of Bellwald. Among residents, the anticipated influence on Bellwald's image appeared to be the strongest explanatory variable. This result corresponds to findings by Jobert et al (2007) and Zoellner et al (2008), which stress the importance of place images in the perception of new energy infrastructure. Tourism is the region's main income source; the importance of the outwardly projected image is evident,

because it is essential to tourism promotion (cf Kokosalakis et al 2006).

Contrary to our hypothesis, sense of place did not influence the acceptance of the avalanche barrier site. Nevertheless, for the Bellwald tourists, the variable *number of visits*, which can be understood as an indicator of attachment to place, was found to explain the response variable with a strong negative relationship. With an increasing number of visits, the relationship with the place and the surrounding landscape seems to intensify. Toured places can therefore become meaningful (as also discussed by Kianicka et al 2006), with the result that tourists prefer to preserve their holiday village as it is. This also underlines Stedman's (2002) findings that people are more willing to fight for the conservation of places that are meaningful to them.

Results also show that acceptance of solar energy production sites is strongly related to the type of site. Three site types could be distinguished, listed from most to least accepted: urban, industrial settings; meaningful buildings; and open lands. In this regard, photovoltaic installations on avalanche barriers were well accepted and only a little less positively rated than installations in urban, industrial settings. Place thus plays a prominent role in the evaluation of possible photovoltaic sites.

Before and during the survey (carried out in March and April 2013), local media reports about the project were widely positive, which might have influenced attitudes toward it. Initial data published in November 2013 showed that the installations were not cost-efficient, and the energy yield was less than expected (Schmidhalter 2014).

This research had 2 main limitations: First, it focused on a small-scale pilot project in an alpine environment. Hence, comparisons with other case studies have to consider local conditions. Second, the small sample of tourists involves a possible bias, because we have to assume that people who were fundamentally interested in the topic were more likely to take part in the survey.

## Conclusion

Because of its nuclear energy phaseout, the Swiss energy system will require successive restructuring in the period up to 2050. In view of this, the Federal Council has developed a long-term energy policy (Energy Strategy 2050) based on the revised energy perspectives. In the initial stage, the Federal Council's new strategy is to focus on the consistent exploitation of existing energy-efficiency potentials and on the balanced use of hydropower and other renewable energy sources (Swiss Federal Office of Energy 2014). The implementation of the Energy Strategy 2050 and the promotion of

renewable energy are accompanied by new challenges concerning environmental protection, economic efficiency, and social priorities. Hence, research on the social acceptance of renewable energy sites can contribute substantially to the understanding of potential opposition to proposed projects and to a sustainable siting process.

This study has shown that the local context is important to consider when discussing solar energy acceptance. It does not suffice to evaluate general

attitudes toward renewable energy to draw a conclusion on whether there will be local opposition to a new project. Rather, diverse aspects can influence local residents' perceptions of new infrastructure. Thus, finding a balance among economic benefits, landscape protection, and residents' and tourists' needs for local progress and preservation is a challenge that must be faced by energy planners and governments on different scales to establish a sustainable energy program.

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## Supplemental data

**TABLE S1** Construction of independent variables based on factor analysis and reliability analysis.

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