

Preferences of Regenerative Energy Production in Switzerland

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Abstract:

In Switzerland, a groundbreaking decision was made by the government: Changing completely from nuclear power to regenerative energies until 2050. This enormous project requires certain knowledge about what stakeholders and the population think about what will change. Despite the question of acceptance and place identity opinions regarding certain forms of energy should be evaluated.

In our study we focused on the ranking of different forms of renewable energies. In a first part an online assessment was created that showed an instruction video of different kind of energy production techniques. In a second part, subjects had to state their attitudes towards different forms of renewable energies in the form of a ranking and state their specific concerns. N=237 subjects participated. Biomass power is regarded as the least favorable type of regenerative energy, whereas solar power constitutes the most favorable type. The raised concerns are specific to every energy form and cannot be generalized. The results are discussed regarding several theoretical implications for project and media design in renewable energy projects.

Keywords:

Acceptance of Regenerative Energies, Preferences, Ranking, Questionnaire.

1. Introduction

In 2011 the government in Switzerland decided to gradually move from nuclear energy to renewable energy sources until 2050 which will require a profound restructuring of the Swiss energy system. In order to successfully achieve this goal, it is important to understand the opinions of stakeholders as well as the general population. Wüstenhagen et al. [1] distinguish between different levels of acceptance towards renewable energies: On a global and general level, public acceptance for renewable energy technologies is high in many countries. According to [1], this positive overall picture has led policy makers to believe that social acceptance is not an issue. But on a more local level regarding specific energy projects social acceptance is usually lower. This is due to the fact that specific projects can pose a threat to the place identity of local residents [2] and raise specific concerns. People's attitude and concerns should therefore be evaluated in regard to specific energy sources.

Wunderlich and Vohrer [3] conducted a survey comparing the population's opinion towards different forms of renewable energy sources in Germany. They asked to what extent people accept different energy technologies in their neighborhood. The results are displayed in Fig. 2:

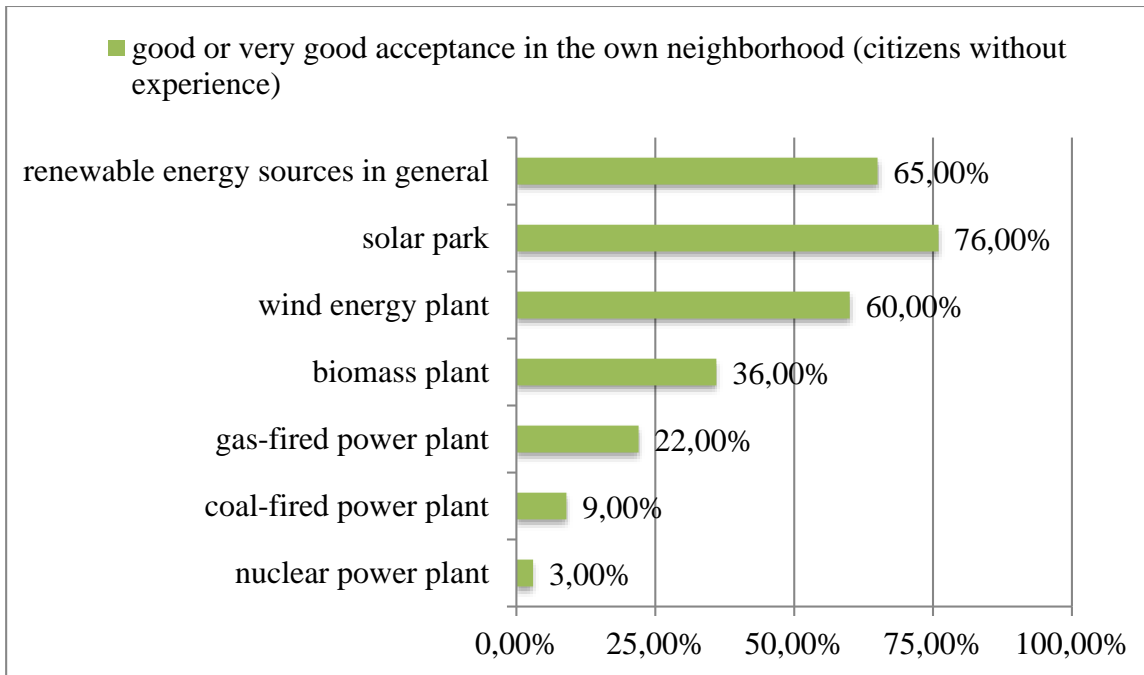


Fig. 2. Acceptance of different energy technologies in the neighborhood (according to [3], p. 8)

Another study by Schweizer-Ries [4] revealed comparable results. Participants were asked for their acceptance and concerns regarding onshore wind plants, solar parks and biomass plants. The questionnaires included different reasons for or against the three forms of energy, such as environmental consequences or effects on natural scenery. The results showed that solar parks are mostly well accepted, whereas biomass plants evoke the most concerns. The change of landscape is seen as the strongest concern regarding wind energy plants whereas malodour, plant cultivation and increased traffic due to freight transport pose the strongest concerns regarding biomass plants.

A telephone survey conducted by Kress and Landwehr [5] showed the following results: Rooftop photovoltaic installations are the most supported technology (82% acceptance), followed by wind energy plants (69% acceptance), solar parks (46% acceptance) and biogas plants (40% acceptance). In accordance with Wunderlich and Vohrer [3] and Schweizer-Ries [4], biomass/biogas is the least accepted of the renewable energies. Additionally, the study participants were also asked about their concerns against the different types of energy sources. The visual appearance and reflection of light were seen as the strongest issue with rooftop photovoltaic installations. Participants were worried most about negative ecological and visual consequences with wind energy plants, about the negative effects on natural scenery concerning solar parks and about monocultures and territorial competitions with food plant cultivation regarding biogas plants.

Scheer et al. [6] chose a different approach: In their study, participants had to rank different energy technologies. Here, the renewable energies also turned out to be the most favorite, but contrary to the described studies, wind energy (offshore and onshore) got the best ranking. Biomass was, however, again regarded as the worst among the renewable energy technologies.

So far no comparable study has been conducted in Switzerland to measure and compare the population's opinion towards different renewable energy sources. The presented studies lay a good foundation to see which types of energy are more accepted and which ones are less. Especially in combination with questions to reveal people's concerns these studies can be a good indicator to see which renewable energy source has the strongest opposition and for what reasons. This can be

interesting for the government as well as for energy providers implementing energy projects. Unfortunately, the above mentioned studies do not contain all relevant renewable energy sources such as water and geothermal energy and can thus not provide the full picture.

Therefore, the aim of this study is to compare the acceptance of all different renewable energy technologies and to bring out the concerns of the participants. The research questions are the following:

- 1) Which forms of renewable energy are the least accepted?
- 2) What are the major concerns that underlie the rejection of specific renewable energy sources?

2. Method

2.1 Sample description

A total of 246 subjects participated in filling up the online questionnaires. Nine of them were excluded due to a large number of missing variables. Therefore, the sample study consists of $N=237$ with the participants' age ranging from 16 to 90 ($M = 35.1$ years, $SD = 13.05$ years). 131 are female and 106 are male. The large majority of 230 people are Swiss residents, whereas the remaining 7 live in Germany. The participants come from all different cantons in Switzerland, but the majority (53.6%) live in Zürich or Bern. Half of the sample are currently working as employees and one third (31.6%) consists of students. Nearly half of the sample (48.5%) have reached a bachelor's degree or a higher educational level and 50.6% earn less than 3700 CHF per month.

2.2 Online questionnaire

The online questionnaire contained four parts. The first part collected demographic data as described above. The second part presented items of a skepticism questionnaire by Hurtt [7] that measures professional scepticism. The detailed description of the measurement of scepticism and the analysis of its influence on the attitude towards renewable energy sources are focused in another article on this study (for further information see [8]). The third part consisted of a visual presentation of a movie¹ about five different energy forms: Geothermal energy, hydropower, solar power, wind power and biomass power. The movie lasted two minutes and gave a simple and comprehensible and neutral overview of these different technologies. It aimed to introduce the subject of renewable energy and to generate a common knowledge base among the participants. After having watched the movie, the fourth and last part of the questionnaire measured the participants' general attitude towards renewable energy sources as well as their attitudes towards the five different energy forms. This was done starting with a request to rank the five different types of energy (only one type per rank), from the least favourable (1) to the most favourable (5). The following items referred to the specific form of energy each person had rated as the least favorable in the ranking part. This procedure had been chosen in order to make the questionnaire less time-consuming. While a ranking shows a comparison between the different forms, it does not provide any information about the attitude the participants have towards them. If biomass power ranked as the least favorable, this does not necessarily mean that this person effectively rejects this form of energy. Thus, the questionnaire contained one item asking for the attitude towards the specific energy source ranked as the most negative. Additionally, the participants had to indicate their subjective level of knowledge about it and several possible concerns against the particular specific energy source were shown as statements that participants could agree or disagree with on a Likert

¹ Accessible under <http://www.youtube.com/watch?v=KWlh2EBbx8s>, minute 2:05 to 3:50.

scale from one to five. The participants were explicitly informed that the statements do not aim to evaluate their knowledge but rather their subjective perception regarding the specific energy form. Due to the complexity of the topic, a five-point scale was preferred to a seven-point scale. Despite the risks of a middle option [9], the five-point scale was chosen in order to give the opportunity to those who are effectively neutral regarding the presented statements. The pretest showed that there was no tendency towards the centre. The statements were created on the basis of a literature research on studies about concerns, such as the ones of Schweizer-Ries [4] and Kress and Landwehr [5], as well as internet sites of resistance groups towards specific forms of renewable energy.

2.3 Data collection

The questionnaire was created online on the platform Unipark. It was accessible for two weeks. On the first day, the link to the questionnaire was distributed over social media sites of the University of Applied Sciences and Arts Northwestern Switzerland and Energie Schweiz as well as through internal mailing lists to all students and staff and the social networks of the research team. The aim was to reach as many people as possible. The participation took around 15 minutes and was on a voluntary basis and no rewards or incentives were offered.

2.4 Data analysis

The statistical analysis was performed with the software SPSS Statistics. It was used to run descriptive calculations to display the participants' attitudes toward regenerative energies and their major concerns. Moreover, Spearman correlations were calculated between the attitude and subjective knowledge level regarding the five specific types of energy.

3. Results

The results regarding the attitude towards regenerative energy sources in general are shown in Fig. 3. 95.8% of the sample expressed a positive or rather positive attitude (value 4 and 5) towards renewable energy sources in general, 3.8% are neutral (value 3) and 0.4%, only one person, showed a negative attitude (value 1).

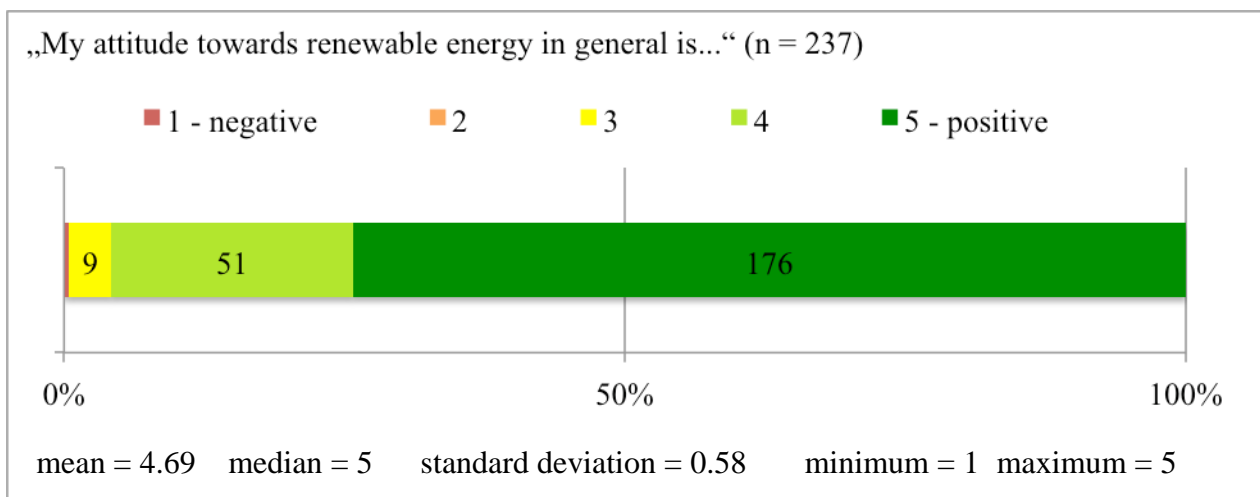


Fig. 3. Attitude towards renewable energy sources in general

The results of the rejection ranking question are presented in Table 1. Biomass power is the technology the participants rejected the most, whereas solar power was seen as the most favorable energy source.

Table 1. The rejection ranking of regenerative energies:

Rejection	Energy type	Mean Rank	Frequency rank 1
highest (1)	Biomass power	2.28	101
2	Geothermal energy	2.78	52
3	Wind power	2.99	37
4	Hydropower	3.07	25
lowest (5)	Solar power	3.93	22

The descriptive results regarding participants' attitude towards the specific energy source ranked as the most negative are summarized in Fig. 5 below:

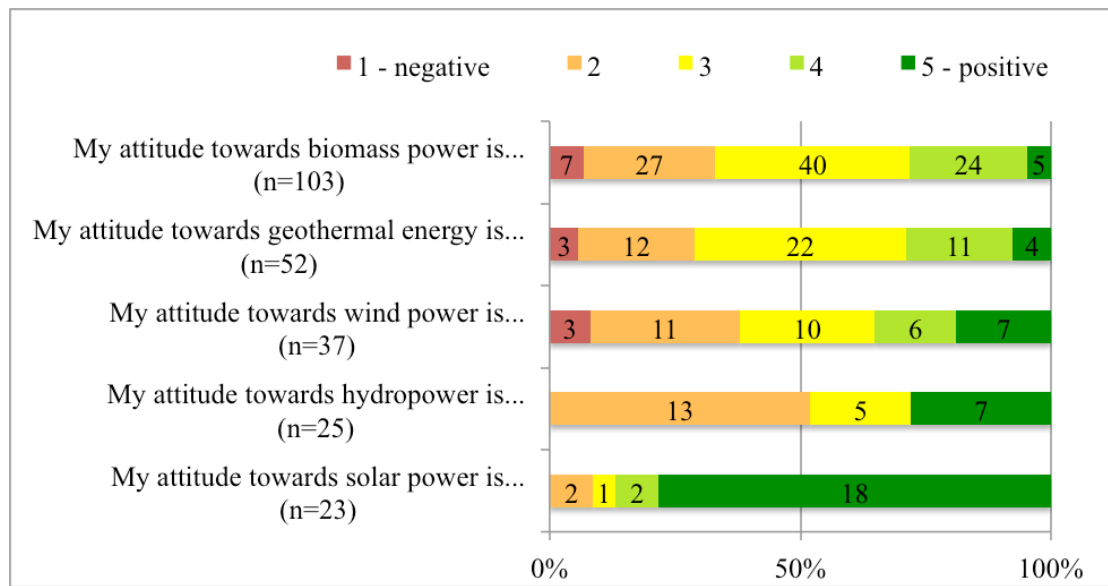


Fig. 5. Attitudes towards the different specific regenerative energy sources

In comparison, hydropower was seen most negatively by the participants who had rated this form as the least favourable in the ranking. Solar power was seen most positively. Biomass power, which is the most rejected in the ranking, was not regarded as negatively as wind power and hydropower by the participants who had ranked the particular energy source as the most rejectable. This means that the participants who rejected wind power or hydropower the most had an especially negative attitude towards these particular forms of energy, compared with the attitude of the other participants towards their as least favourable ranked forms.

In order to find out more about the concerns the participants have about the different types of energy, we presented several possible concerns against the energy the participants individually had rated as the least favourable in the ranking. The concerns were formulated as statements the participants could rate on a Likert scale between 1 (no agreement) to 5 (total agreement). The biggest concerns (highest means) regarding every energy source are shown in Tables 2 to 6:

Table 2. Major concerns against biomass power:

Concern	Mean	Median	SD	Min	Max	N
Such plants cause territorial competitions between the cultivation of food plants and plants for biogas production.	3.90	4	1.22	1	5	98
Such plants cause malodour.	3.11	3	0.99	1	5	98
Such plants increase traffic due to freight transport.	3.07	3	1.18	1	5	98

Table 3. Major concerns against geothermal energy:

Concern	Mean	Median	SD	Min	Max	N
I am worried such plants can cause earthquakes.	3.31	4	1.28	1	5	52
The community population has too little opportunity to participate.	2.90	3	1.14	1	5	52
Such plants cause conflicts in the community.	2.71	3	1.13	1	5	52

Table 4. Major concerns against wind power:

Concern	Mean	Median	SD	Min	Max	N
Such plants decrease the value of surrounding property.	3.81	4	1.05	1	5	37
Such plants disturb the natural scenery.	3.78	4	1.11	2	5	37
Such plants endanger birds.	3.32	4	1.33	1	5	37

Table 5. Major concerns against hydropower:

Concern	Mean	Median	SD	Min	Max	N
Such plants cause negative effects on the flora and fauna.	3.80	4	1.38	1	5	25
Such plants cause additional costs for the correction of negative ecological effects.	3.28	4	1.17	1	5	25
Such plants disturb the natural scenery.	3.28	3	1.10	1	5	25

Table 6. Major concerns against solar power:

Concern	Mean	Median	SD	Min	Max	N
Such plants cause substantial costs for the grid expansion.	2.27	2.5	1.28	1	5	22
The production of this technology creates new jobs in foreign countries rather than in Switzerland.	2.18	2	1.37	1	5	22
Such plants increase the cost for electricity.	2.14	2	1.04	1	4	22
The production of this technology requires more energy than this technology ever can produce.	2.14	2	1.39	1	5	22

Furthermore, in the questionnaire participants were also asked how much they subjectively knew about the form of energy they had ranked as the least favorable. The subjective level of knowledge

did not significantly correlate with the attitude a person had towards this specific energy type, as it can be seen in Table 7:

Table 7. Correlations between subjective level of knowledge and attitude towards the specific energy types:

	Spearman-Rho	Significance	n
Biomass power	r=-.104	p= .298	102
Geothermal energy	r=.190	p=.177	52
Wind power	r=.052	p=.761	37
Hydropower	r=-.131	p=.533	25
Solar power	r=.016	p=.943	23

4. Discussion

The first aim of this study was to find out which forms of renewable energy are the least accepted. With our survey we could obtain a picture of the opinion and mood people in Switzerland have towards regenerative energies. On a general level, the results show a very positive attitude which matches the findings of Wüstenhagen et al. [1]. Biomass power is regarded as the least favorable type of regenerative energy, whereas solar power constitutes the most favorable type. The results are therefore comparable to the studies presented in the introduction [3-5]. Our second aim was to reveal the major concerns that underlie the rejection of specific renewable energy sources. These concerns (ecological, economical, aesthetic,...) differ between the specific energy forms and are therefore not generalizable over all types of renewable energy. Regarding biomass power, the participants are most worried about territorial competition with the cultivation of food plants, malodor and increased traffic, confirming the results found by a previous study [4]. Major concerns regarding geothermal energy include earthquakes, too few possibilities of participation and conflicts in the community. For wind energy it is the decreasing value of property as well as the disturbance of natural scenery and danger for birds. Regarding hydropower the major concerns are the negative ecological effects, the resulting costs as well as the disturbance of the natural scenery. Lastly, increasing grid expansion and rising electricity costs and the fact that new jobs are created abroad rather than in Switzerland are concerns against solar power. Contrary to the study of Kress and Landwehr [5], the visual appearance did not pose one of the main concerns.

Due to the small number of participants and the composition of the sample, our results cannot be seen as representative for Switzerland. The sample is composed of one third of students, the age average is rather low and nearly half of the participants have reached a tertiary level of education. Kress and Landwehr [5] found in their study that the acceptance for wind energy plants and rooftop photovoltaic installations is higher with young people than with elder ones. In addition, they revealed that the acceptance for biogas plants is higher for persons with secondary or tertiary education level than for those with only primary education level. Therefore, a larger and representative sample could possibly lead to slightly different results. Moreover, in order to limit the amount of time required to fill out the questionnaires, we did not differ between all possible types of renewable energy, such as splitting solar energy up into rooftop photovoltaic installations and solar parks or geothermal energy into deep geothermal energy and geothermal energy for homes. This could have affected the answers of the participants about their attitude and concerns.

Despite the above mentioned limitations, the results of our study provide a valuable approach to set a starting point. They provide a basis for energy providers planning and implementing specific

energy projects as the major concerns against specific forms of energy are known and can be taken into account. While informing local residents of a planned energy project, exactly these aspects can be considered and actively brought into discussion. Concerning the construction of biomass power plants, as an example, project leaders might focus on how to limit territorial competition with the cultivation of food plants, to minimize malodor and to deal with the freight transport to avoid increased traffic if they want to achieve better acceptance for the project.

Following Wüstenhagen et al. [1], acceptance can decrease from a general to a local reference context, regarding concrete energy projects. As our questionnaire surveyed attitudes and concerns towards specific energy forms on a general level but not in connection with a particular project, additional concerns could arise in a local context. This leads us to the implications for future research: It would be worthwhile to test the presented results against the background of concrete local energy projects. The use of qualitative methods could be a valuable complementation to gain a deeper understanding of people's attitudes and specific concerns.

According to our findings, a subjectively low level of knowledge cannot be seen as a reason for a negative attitude towards the least preferred energy type. We only measured the subjective level of knowledge but not the objective level of knowledge the participants had about renewable energies. For future research it could be interesting to test whether and how systematic knowledge about regenerative energy technologies influences people's attitudes towards and concerns about specific energy forms. The knowledge of participants about renewable energy technologies could be manipulated regarding different methods of conferring facts (e.g. in written or spoken form, through pictures or films), its complexity or the content itself and analyzed in terms of the influence on attitude and concerns towards regenerative energy sources.

5. Conclusion

The presented study draws a picture of the opinion and mood people in Switzerland have towards different regenerative energy types and what they are concerned about, regarding specific energy forms. The results show a very positive attitude towards regenerative energies in general. The challenge in order to manage the changeover to renewable energy sources until 2050 will be to gain acceptance and support in a local context for the realization of specific energy projects. The results of this study provide a basis for energy providers to learn more about citizens' attitudes and concerns towards renewable energy sources, which therefore can be addressed and taken into account during the process of planning and construction of energy plants. Further studies are needed to achieve a larger and representative sample for the Swiss population and to deepen the understanding of people's attitudes towards renewable energies and the associated concerns, of how they arise and how they can be influenced, e.g. by providing specific knowledge.

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