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PUBLIC ACCEPTANCE OF RENEWABLE ENERGIES IN BAVARIA USING THE EXAMPLE OF BIOMASS COGENERATION PLANTS AND BIOGAS PLANTS

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ABSTRACT: Decentral renewable energy supply requires a higher number of plants and affected residents since centuries. Despite many advantages, like e.g. reduction of greenhouse gases due to use of renewable energies, residents are confronted with various emissions due to such plants. However, the turnaround to regenerative energy supply can only be realized if citizens accept these new technologies in their neighborhood. This paper presents the findings of two surveys concerning public acceptance of biomass cogeneration plants (BCP's) and biogas plants (BGP's) in Bavaria/Germany. Data was collected at 5,000 households in the neighborhoods of ten BCP sites and one BGP site. Results show a high level of public acceptance, lacking information among residents, almost no Not-in-my-Backyard behavior (NIMBYism) and essential differences between incentives and arguments of proponents and opponents of plants. Findings deliver useful information concerning project development to plant operators.

Keywords: Renewable Energies, Public Acceptance, Plant operator, Project development

1 INTRODUCTION

Currently, Germany is the major producer of biomass-based primary energy in the EU [2]. The number of biomass cogeneration plants and biogas plants in Germany, most notably in Bavaria, has multiplied in recent years due to attractive payments granted by the German renewable energy law (EEG).

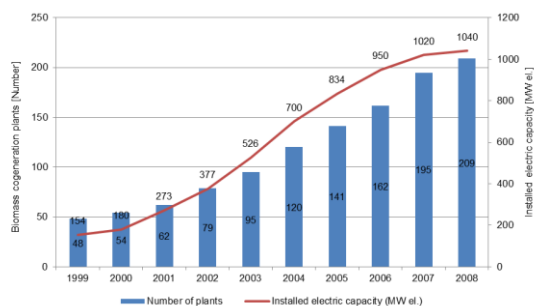


Figure 1: Number of biomass cogeneration plants in Germany and installed electric capacity. Own figure, by [12].

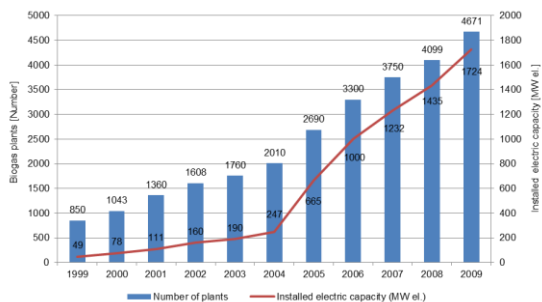


Figure 2: Number of biogas plants in Germany and installed electric capacity. Own figure, by [5].

Figure 1 and Figure 2 show the development of BCP's and BGP's in Germany in the last decade. Next to the development of new technologies and science, the atti-

tude of a society towards a specific technology is an important determinant which forms the economic evolution of a country in a decisive way [7]. Investigations of acceptance of specific technologies were induced in the course of large-scaled (risk) technologies most notably in the areas of genetic engineering and nuclear power. Although the Federal Government of Germany decided to phase out nuclear power in the end of May 2011, this giant step in the development of German economy towards regenerative energy supply can only be realized if citizens approve and accept new energy technologies in their neighborhood. Acceptance is defined as the character of an innovation to arouse positive reactions of affected people at its initiation [1]. The public acceptance of biomass cogeneration and biogas plants in Bavaria was the subject of two investigations ([10] and [11]) since public acceptance is one of the most important barriers on the way to project realization. The findings of this study, in particular information concerning the influencing factors of public acceptance offer useful information for plant operators for a deeper understanding and enhancement of public acceptance.

2 PROBLEMS

A growing skepticism towards global transboundary risk potentials in society in the past 40 to 50 years (mainly due to nuclear power projects) is responsible for increased prejudices in society concerning the realization of new technologies [3]. In the case of renewable energy technologies, next to technical, organizational, administrative or infrastructural obstacles, perception and acceptance of citizens can constitute a massive barrier in project development [9]. The wrong handling and management of acceptance problems can lead to dismissal of bioenergy projects in particular cases. Subjective factors, like e.g. the general bad societal perception of solid matter combustion (equal view of BCP's and waste incinerating plants which have an especially bad image) or ethical concerns towards the energetic use of cereal plants ("tank vs. plate discussion"), must not be underestimated. An-

other example for such subjective factors are the attributes that people in Germany associate with the word "biogas". For many German citizens, this word arouses negative implications like bad smell or dirt, without even knowing anything about this technology. The mentioned aspects which influence public acceptance are often a consequence of insufficient knowledge of energetic use of biomass - a rather "young" and up-to-now little known technology [4]. This can lead to negative attitudes and resistance from people who are generally pro renewable energies. They change their positive attitudes if such plants for energetic use of biomass (like for example BCP's or BGP's) should be established in their direct neighborhood. This reaction is called "Not-in-my-backyard-effect" (NIMBY-effect). "Everybody likes the use of renewable sources for the provision of energy but Not In My Back Yard" [9]. This denotes a behavior of people to deflect threats and trouble to others. The term "NIMBY" can also relate to persons: A NIMBY is a person who opposes particular construction of projects in their community [13]. The aim of this study was to develop a tool using a standardized questionnaire to measure the acceptance of residents of a selected distribution of bioenergy facilities, to analyze influencing factors on public acceptance, to prove or to disprove a potentially existing NIMBY-effect related to BCP's and BGP's in Bavaria, to depict reasons for acceptance-problems as well as to identify developments and tendencies of public acceptance and to align these findings with recommendations for plant operators in literature respectively to generate new recommendations for plant operators for communication and PR activities.

3 METHOD

Technical-acceptance-research cannot be allocated to a certain scientific discipline, since different scientific disciplines contribute to it. Amongst others these are opinion research, media research, and socio-scientific risk research [6]. Different to most branches of natural sciences, no calibrated instruments for direct measurement of technical acceptance existed until the end of the recent century [8]. This situation has not changed until 2008 since there is no consistent concept for measuring technical acceptance. A wide range of different measurement-techniques and methods exist in this field and the researcher is relatively free in the choice of the appropriate research approach. The choice of the measuring instrument depends on the cognitive interest and the cultural context with which the concerned study is connected [3]. For the two subjects of investigation (BCP's and BGP's), the same strategy of data acquisition was chosen, a written survey. Basic populations were the Bavarian population as a whole in case of BCP's (poll was conducted at ten different plant sites all over the federal state), respectively the population of one Bavarian city in case of BGP's (poll was conducted only at one plant site). For every plant site (for each of the ten BCP's, as well as for the BGP), specific regions were selected in two different distances to investigate the influence of distance on public acceptance respectively to check the presence of a NIMBY-effect: "Nearby regions" (direct neighborhood, 0-500 m) and "distant regions" (more far off, 2,000 m plus). Two similar questionnaires were developed, one for the ten BCP's ("Survey 1") and one for the single BGP ("Survey 2") and improved through expert

interviews. After pretesting, 5,000 copies were manually distributed to private households, 3,000 for Survey 1 (300 copies per plant; 150 per "nearby region", 150 per "distant region") and 2,000 for Survey 2 (1,000 copies per "nearby region", 1,000 per "distant region"). The rate of return for Survey 1 was 10.7 % (322 returned questionnaires in total) with an almost equal number of answers from "nearby regions" and from "distant regions". The rate of return for Survey 2 was 8.6 % (172 returned questionnaires in total). In this case, there was a clear majority of answers from the nearby region (10.6 %) whereas the distant region only provided 6.6 %. Both surveys were quite similar, the main differences are the sort of the examined renewable energy plant and the number of distributed questionnaires per plant (Survey 1: 3,000 for ten plant sites / Survey 2: 2,000 for one plant site). In case of Survey 1, this strategy was chosen, first, to get an overview over acceptance over the whole country, and second, to find out more detailed information by selecting the ten plants by specific attributes. Among the ten selected plants were biomass cogeneration heat plants as well as biomass cogeneration heat and power plants. There were large-scale plants as well as small-scale plants, plants with high acceptance in the planning phase as well as plants with low acceptance in the planning phase. Some plants were already running for a long time when the data acquisition was done, while some plants were quite new.

The statistical evaluation was carried out with PASW Statistics 18 by means of descriptive statistical methods: Relative frequencies, arithmetic averages and cross tabulations. Depending on scales of measurement, statistical tests on significance were conducted (t-test or chi-square test) with the level of significance being 0.05.

4 RESULTS

4.1 General information about the samples

The samples of both surveys show an overbalance of male respondents (2/3 respectively 3/4 of returned questionnaires). This might be responsible for a distortion of results because particularly in rural areas, women possibly spend more time at home and are exposed to emissions of BCP's for longer periods of time what might be a reason for a lower acceptance among women. Most respondents belong to the age group 41-70 years. The degree of education of the respondents is rather high in case of Survey 1 (more than half has a certificate of access to higher education or a university degree). Respondents of Survey 2 are less educated, almost 50 % declared a vocational qualification as their highest level of education. About half of the respondents live in two-person-households and only a small part of the households accommodates children younger than 18 years. The vast majority of residents in the nearby, as well as in the distant regions knew about the existence of the plant in their neighborhood, in Survey 1, about 75 % knew, in Survey 2, over 90 % knew (certainly due to the size of the investigated BGP, which belongs to the largest biogas plants in Germany). Respondents of Survey 1 additionally were asked, where they got to know about the plants, the most common sources of information were newspapers, neighbors/friends/acquaintances, community-gazettes or public information meetings. The investigated biogas plant feeds methane in the natural gas net, why residents of this plants cannot purchase heat from it. In case

of Survey 1, the interviewees were asked if they purchase heat from the plant in their neighborhood. 30 % of the people in the nearby regions, and 13 % in the distant regions do so. The respondents of both surveys have a distinct environmental consciousness, they have very positive attitudes towards renewable energies, are aware of shortage of resources (and therewith of the necessity of a decentral energy supply from regional resources) as well as of climate change. Concerning the energetic use of biomass there are as well quite positive positions, although high proportions of undecided individuals are also part of the sample.

4.2 Comparison of nearby and distant regions

In the following, the results of both surveys are presented, according to nearby and distant regions. Anticipatory it can be said that almost no significant differences between the allocations of answers from the nearby regions compared to the answers from the distant regions were found. In case of Survey 1, there are only two queried statements with significant differences between nearby and distant regions. „If you think about the plant in your neighborhood, how is your predominant impression?“ and „Which predominant impression concerning the plant do your neighbors have in your opinion?“. The answers given on these statements show that the overall impression concerning the plants is a little better in the distant regions what constitutes a hint for NIMBYism concerning BCP's in Bavaria. In the distance regions, the overall impression of neighbors is significantly better. This is another hint for NIMBYism. Interestingly, about 60 % of the interviewees do not know what their neighbors think, what might be a sign that the acceptance of BCP's is so high, that the respondents do not communicate about this issue. In case of Survey 2, significant differences were as well only found for two statements. „Would you support a citizens' initiative who engages against the construction of a further BGP in your neighborhood?"; almost two thirds from the nearby regions and more than fifty percent from the distant regions would support a citizens' initiative, what may be due to the extraordinary size of the BGP. In case of Survey 1, no significant differences concerning this statement were found. Inhabitants of the nearby regions answered that they would not sympathize to curly 75 %, inhabitants of the distant regions wouldn't do so to an extent of 85 %. The other significant statement in Survey 2 is „The BGP influences the value of my real property!“. Almost half of the respondents from the nearby region thinks that there is an influence. In the distant regions, only 28.3 % do so. Interestingly, in case of Survey 1, the majority (more than thirds) of respondents does not think that there is an influence, the rest believes in equal parts that there is a negative respectively a positive influence, see Figure 3.

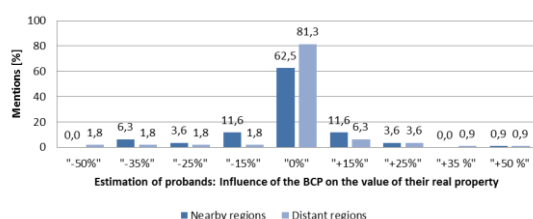


Figure 3: Influence of the BCP on the value of real property (answered by respondents who live in proprietary - nNearby regions = 112 / nDistant regions = 112). Own source 2010.

The answers to these statements were the only hints for a NIMBY-effect in the case of BCP's and the BGP within these two studies. All other tested statements brought almost no further significant differences (with only very few exceptions) between the allocations of answers from the nearby regions compared with the distant regions.

In Survey 1, a differentiated query about specific annoyances accompanied with BCP's was conducted. No matter if nearby region or distant region, the most important disturbances are: (order according to potential of disturbance)

1. Dust emissions as a consequence of combustion of the fuel
2. Optical/esthetical aspects in coherence with the chimney of the plant
3. Optical/esthetical aspects in coherence with the steam resigning out of the chimney
4. Noise emissions as a consequence of delivery of the fuel
5. Odour emissions
6. Increased traffic volume as a consequence of delivery of the fuel

Inhabitants of the nearby regions do not feel more disturbed than inhabitants of the distant regions do, no matter what kind of disturbance was requested in Survey 1. Not less than 50 % to 80 % of the interviewees stated that there is "No disturbance" (on a Likert scale from "No disturbance" to "Massive disturbance"). That means that BCP's only annoy a very small proportion of the Bavarian society. Also in case of Survey 2, respondents almost do not feel disturbed. At most queried statements, more than half of the respondents shows a positive attitude. Only concerning the statements which relate to a direct impacts on the residents "The biogas plant stinks" and "The biogas plant causes more traffic", especially residents in the nearby region feel more disturbed, but not to a significant degree.

At Survey 1, the respondents who purchase heat from the BCP in their neighborhood were asked "Would you connect your household to a BCP for heat supply again?". In the nearby regions, about 75 % would do so again, in the distant regions about 85 % would, but the difference is not significant. Very interesting is, that arguments of respondents who would get connected again are both of global (environment/climate) and of regional (regional value creation/employment) nature. Respondents who would not get reconnected on the contrary exclusively state egoistic reasons (dependency/contract obligations/transparency of cost). The interviewees of Survey 1 also were asked: „Presumed you move to another place, would you unconditionally move close (in sight distance) to a BCP again?“ In the nearby regions as well as in the distant regions about 60 % would move in the neighborhood of a BCP again. Interesting again in this case is that respondents who would not move in the neighborhood of a BCP again show strongly egoistic motives, whereas those who would move there again give global and regional arguments. Interesting in this connection as well is the fact that a minority of opponents designates as many arguments than a vast majority of proponents. The opponents were much more creative with their arguments, obviously better informed and brought a lot of arguments why they would not move close to a BCP again. Another question, the respondents of Survey 1 had been asked was "How good do you feel informed about the BCP in

your neighborhood?”. Both groups “nearby regions” and “distant regions” only feel moderately informed about the plants (see figure 4). In the nearby regions, 85 % of the respondents wish more information, in the distant regions 75 % do so. The preferred sources of information would be (in the sequence of responses): Newspapers, community-gazettes, plant-visits, flyers, public information meetings, municipal administration, internet, television and radio.

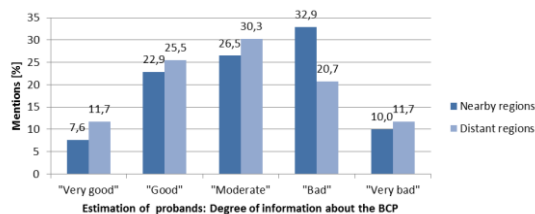


Figure 4: “How good do you feel informed about the BCP in your neighborhood?” (nNearby regions = 170 / nDistant regions = 145). Own source 2010.

4.3 Significant parameters which influence the social acceptance of biomass cogeneration plants (results only from Survey 1)

To identify parameters that have significant influence on the respondents’ acceptance, the answers to the questions (these answers allow precise conclusions on the respondents’ acceptance behavior) „If you think about the plant in your neighborhood, how is your predominant impression?“, „Which influence does the BCP have on the value of your real property?“, „Presumed you move to another place, would you unconditionally move close (in sight distance) to a BCP again?“ and „Would you sympathize with a citizens’ initiative who engages against the construction of a further BCP in your neighborhood?“ were cross-tabulated with various answers given on statements from the fields “social demographics”, “heat delivery”, “general environmental consciousness”, “position concerning renewable energies” and “degree of information.” All in all 116 cross-tabulations were compared, Table I shows the outcoming essential implications.

	Social demographics	Heat delivery	General environmental consciousness	Position concerning renewable energies	Degree of information
Significant impact on acceptance of respondents?	No	Yes	No	Yes	Yes

Table I: Issues with significant impact on social acceptance of BCP’s in Bavaria. Own source 2010.

The substantial cross-tabulations show that social demographics and the general environmental consciousness of respondents do not affect public acceptance of BCP’s in Bavaria. On the contrary, what decisively affects public acceptance is if residents purchase heat from the plant, if they have a positive attitude towards renewable energies, and, first of all their degree of information about the plant in their neighborhood.

4.4 Findings from comparisons of selected biomass cogeneration plants (results only from Survey 1)

Furthermore, direct comparisons inside the pool of the ten different BCP’s with different attributes were made. The results of these comparisons show that the size of a plant influences the acceptance of residents. Residents who live in the neighborhood of small plants estimate the influence on their real property value more positively than residents who live in the neighborhood of large plants, they would more often move to the neighborhood of a BCP again and they would sympathize with a citizens’ initiative against a further BCP to a lower extent. Next to the “factor plant” size, the factor „time“ as well influences the acceptance in a decisive way: A low acceptance in the planning phase of a plant affects further acceptance over years. Comparisons between plants with a high level of acceptance in the planning phase with plants with a low level of acceptance in the planning phase show that public acceptance changes over the years and evens out on a certain level. The longer the elapsed time, the better the acceptance of plants with a low acceptance-attitude in the planning phase seems to become.

5 RECOMMENDATIONS FOR OPERATORS

Altogether, public acceptance of BCP’s in Bavaria and of the one tested BGP is on a high level, although the majority of respondent’s need for information about the plant in their neighborhood is not satisfied, especially in the case of Survey 1. One essential message from the two surveys is that there is a necessity for intense, creative, complex and sustainable publicity for planned as well as for established plants to counteract a lack of information of aggrieved residents. The following findings from Survey 1 constitute this necessity: The average of interviewees of this study only feels moderately informed about the plant, more than 75 % wish for more information about the concerning plant, 40 % of the respondents wished an abstract with more information. Furthermore, as the presented results of Survey 1 show, the degree of information has a significant impact on public acceptance. The following aspects should be an integral element of publicity concerning biomass based bio-energy plants. Operators ideally should include them as a part of their plant project development:

1. A creation of a problem-consciousness of people
2. An accentuation of the potential of renewable energies for environmental- and climate protection
3. A description of opportunities of usage of renewable energies and their consequences on a region value creation
4. A demonstration of solutions through established media already in an early stage of the project development of a plant

Furthermore, plant operators should offer plant-visitations (“Open day”), roofing ceremonies, press releases, information panels or cooperations with very important persons.

All in all it can be stated that public acceptance is a credit, which the operating company has to gain through activities with the aggrieved residents!

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