PUBLIC ACCEPTANCE OF BIOMASS COGENERATION HEAT (AND POWER) PLANTS (BCH(P)P´S) IN BAVARIA

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ABSTRACT: The outcomes of a survey analysing public acceptance of biomass cogeneration heat (and power) plants (BCH(P)P´s) of 3,000 Bavarian households in the neighbourhood of ten BCH(P)P´s are reported in this paper. Acceptance was measured in two different distances to plants in order to check for the so-called "Not-in-my-backyard effect" (NIMBYism): Nearby regions (0-500 m) and distant regions (2,000 m plus). The survey results show that public acceptance is better than expected and interviewees only feel very little disturbed by BCH(P)P´s. The motives of plants´ proponents fundamentally differ from the motives of the few opponents, who mainly raise egoistic reasons, whereas proponents have a look on their regions´ welfare respectively the well-being of the planet. Furthermore, there are huge deficits in residents´ information. There is only little evidence for distance-related NIMBYism in case of the surveyed sites. In contrast, aspects like "heat-delivery", "attitudes towards renewable energies" and "degree of information" have significant impact on the acceptance of the respondents. Besides the factors "plant-size", "attitudes towards plants in the planning phase" and "runtime" (regardless the acceptance status in the planning phase) seem to affect public acceptance for years. Furthermore, public acceptance tends to change to an intermediate level -even if acceptance in the planning phase was high.
Keywords: 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 heat (and power) plants in Germany, most notably in Bavaria (the federal state with the highest stocks of wood), has multiplied in recent years due to attractive payments granted by the German renewable energy law (EEG). Despite many advantages, like e.g. reduction of greenhouse gases due to use of renewable energies, residents can face various emissions by such plants (like noisiness, air pollutants, off odours, increasing traffic, settled dust, explosion hazard or adverse effects on landscapes).

Public acceptance of such biomass cogeneration heat (and power) plants in Bavaria was the subject of this study since this factor is one of the most important barriers on the way to project realization. Thereby, findings concerning influencing factors of public-acceptance were regarded to deliver useful information for plant operators in order to enhance public acceptance for running plants as well as for planned plants.

Acceptance is defined as the character of an innovation to arouse positive reactions of affected people at its initiation [1]. Investigations to measure 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. Next to the development of new technologies and science, the attitude of a society towards a specific technology is an important determinant which forms the economic evolution of a country in a decisive way [6]. The turn to a regenerative energy supply can only be realized if the population in a specific region (first of all those who come in direct contact with these new energy facilities) approve and accept these technologies.

2 PROBLEMS

Because of the societies´ increasing skepticism towards global transboundary risk potentials in the past 40 to 50 years (mainly due to nuclear power projects), public acceptance can no longer be presumed for the development and implementation of new technologies [3]. Next to technical, administrative, organizational and infrastructural challenges during the establishment of BCH(P)P´s, perception and acceptance of the residents living in the neighbourhood of such plants can constitute a massive obstacle for this kind of ventures as well [8]. In the case of BCH(P)P´s, the wrong handling and management of acceptance problems can lead to dismissal of projects in particular cases. Most notably the following externalities caused by BCH(P)P´s can lead to opposition in the public, whereas it is irrelevant whether these oppositions are objectively justified or not [4]:

1. Increased local emissions of contaminants
2. Emission of odours
3. Increased traffic
4. Adverse effects on landscape appearance
5. Formation of fogs

The impacts of subjective factors, like e.g. the general bad societal perception of solid matter combustion or ethical concerns towards the energetic use of cereal plants ("burning of bread"), must not be underestimated. The mentioned aspects are often a consequence of insufficient knowledge of energetic use of biomass - a rather "young" and up-to-now little known technology [4]. It can happen that citizens who are generally pro renewable energies tend to act contrariwise if such plants (like for example a BCH(P)P) should be established in their direct neighbourhood. This behaviour 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" [8]. 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 [9].
The aims of this study were to develop a tool using a standardized questionnaire to measure the acceptance of residents of 10 specifically selected BCH(P)P´s, to analyze influencing factors on public acceptance, to prove or to disprove a potentially existing NIMBY-effect related to BCH(P)P´s in Bavaria, and to depict reasons for acceptance-problems. Afterwards, the results of the survey are compared with recommendations for plant operators in literature 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, socio-scientific risk research as well as science and technology generation-related research [5]. Different to most branches of natural sciences, no calibrated instruments for direct measurement of technical acceptance existed until the end of the recent century [7]. This situation has not changed until 2008 since there is no consistent concept for measuring technical acceptance. Rather exist a wide range of different measurement-techniques and methods and the researcher is relatively free in the choice of the appropriate research approach. The choice of the measuring instrument depends on the targets of the study, the interests of the researcher and the cultural context connected to the project [3].
For the study on hand, in a first step written surveys were conducted at ten plant-sites which were selected taking into account the following attributes:

- Biomass cogeneration heat plants as well as biomass cogeneration heat and power plants
- 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
- Plants running for a long time as well as plants running for a short time

For every selected plant site, “nearby regions” (direct neighbourhood, 0-500 m) and “distant regions” (more far off, 2,000 m plus) were defined to investigate the influence of distance on public acceptance and to check the presence of a NIMBY-effect concerning BCH(P)P´s. A questionnaire was developed and improved through expert interviews. After pretesting, 3,000 copies were manually distributed to private households in the two different areas from the plants (300 copies per plant; 150 per “nearby region” and 150 per “distant region”). The overall rate of return was 10.7 % (322 returned questionnaires in total) with an almost equal number of answers from “nearby regions” and from “distant regions”. 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 sample

The sample shows an overbalance of male respondents (two-thirds 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 thus are more exposed to emissions of BCH(P)P´s for longer periods of time what might be a reason for a lower acceptance among women. Most answers came from the age group 41-60 years. The degree of education of the respondents is rather high (more than half has a certificate of access to higher education or a university degree). Nearly half of the respondents live in two-person-households, two-thirds of the households do not accommodate children younger than 18 years.

30 % of the interviewees in the nearby regions purchase heat from the plant in their neighbourhood, in the distant regions about 13 % do so. Both, in the nearby regions and in the distant regions, about 75 % of the interviewees knew about the existence of the plant. The most common sources of information are newspapers, neighbours/friends/acquaintances, community-gazettes or public information meetings.

The respondents generally show distinct positive attitudes towards environmental themes and aspects related to saving of energy. The results of the survey indicate very positive attitudes towards the queried general topics such as renewable energies, climate change and shortage of resources. In case of more specific themes such as the energetic use of biomass or BCH(P)P´s, respondents still have quite positive attitudes but we observe relatively high proportions of undecided individuals as well.

4.2 Comparison of nearby and distant regions

According to the results of the survey only small evidence could be found for the existence of a NIMBY-effect in case of BCH(P)P’s in Bavaria. Although the answers to the following two statements significantly differ between nearby and distant regions *„If you think about the plant in your neighbourhood, how is your predominant impression?”* and *“Which predominant impression concerning the plant do your neighbours have in your opinion?”,* the answers do not allow to claim a clear NIMBY-effect. In general the overall impression of the respondents concerning BCH(P) plants is slightly better in the distant regions (what could constitute a hint for NIMBYism). The same relates to the overall impression of neighbours which is significantly better in distant regions as well. Interestingly, about 60 % of the interviewees do not know what their neighbours think about the BCH(P) plants in their neighbourhood. This could be interpreted in the sense that people’s acceptance of BCH(P)P´s is so high, that the respondents do not communicate about this issue. Altogether the answers to these two questions were the only two hints for a NIMBY-effect in the case of BCH(P)P´s in Bavaria within this study. All the other included questions within the questionnaire brought no further evidence for NIMBYism. For example no significantly differing responses could be observed concerning the statement *„Which influence does the BCH(P)P have on the value of your real property?”* between nearby and distant regions. The majority of respondents (more than two thirds) believe that there is no influence, the rest believes in equal parts that there is a negative respectively a positive effect (compare figure 1).

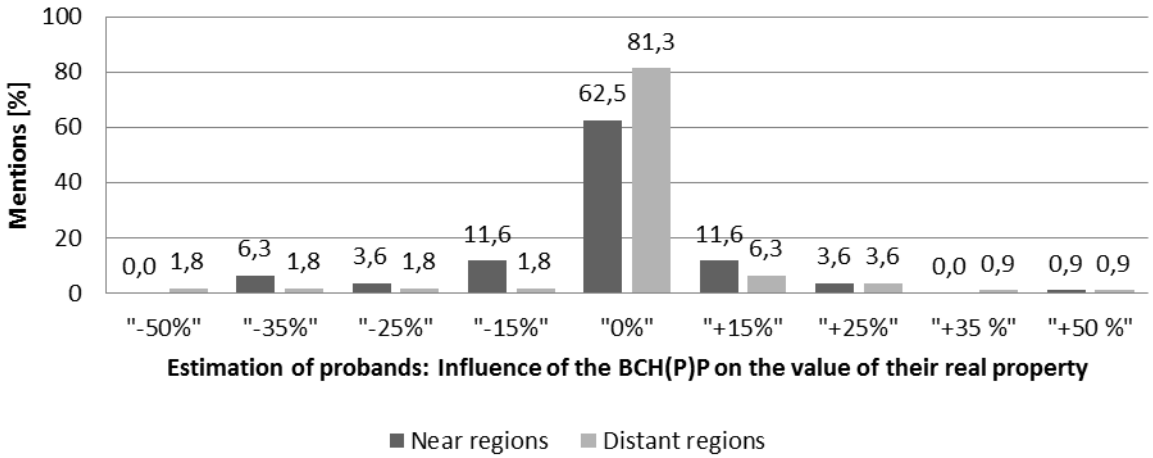

Figure 1. Influence of the BCH(P)P on the value of real property (answered by 112 respondents who live in proprietary in nearby regions and by 112 respondents living in distant regions). Own source 2010.

No significant differences were also found for responses related to the main annoyances due to BCH(P)P´s, since in general inhabitants of the nearby regions do not feel more disturbed than inhabitants of the distant regions. The following most important disturbance factors of BCH(P) plants were mentioned from respondents independent of the distance of the plants:

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 discharging 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

Altogether BCH(P)P´s only annoy a very small proportion of the neighbouring population since 50 % to 80 % of the interviewees stated that there is *"No disturbance"* (on a five-type scale from *"No disturbance"* to *"Massive disturbance")* independently what kind of disturbance was asked in the questionnaire.
The persons who purchase heat from the plant in their neighbourhood were asked *"Would you connect your household to a BCH(P)P for heat supply again?".* In the nearby regions, about 75 % would do so again, in the distant regions about 85 % would buy heat again but the difference between the regions is not statistically significant. Arguments of residents who would get connected again are both of global nature (like e.g. environmental protection/climate change) but include regional aspects as well (like e.g. regional value creation/employment in the region). In contrast, residents who would not get reconnected again exclusively state egoistic reasons (like e.g. dependency/contract obligations/transparency of cost).
In an additional part of the questionnaire the interviewees were asked: *„Presumed you move to another place, would you unconditionally move close (in sight distance) to a BCH(P)P again?"* About 60 % of the respondents would move in the neighbourhood of a BCH(P)P again, both in the nearby regions as well as in the distant regions. In this context those residents who disagreed to this question show strongly egoistic motives, whereas those who agreed show global and regional arguments. An interesting detail is the fact that the minority of opponents mention as many arguments for their opinion like the vast majority of proponents, i.e. the opponents were much more creative and raised a high number and big variety of arguments why they would not move close to a BCH(P)P again.
Responding to the question *„Would you sympathize with a citizens´ initiative who engages against the construction of a further BCH(P)P in your neighbourhood?"*, around 75 % of the inhabitants of the nearby regions would not sympathize with such an initiative compared to around 85 % of the inhabitants of the distant regions (however the difference is not statistically significant). Although the "oppo-

nents" of BCH(P)P´s are only a few respondents in this case, they delivered almost as many arguments as the "proponents".
Finally, no significant differences were found between the answers from the nearby regions compared to those from the distant regions concerning the information provided about the BCH(P)P in their neighbourhood. In both regions people only feel moderately informed about the plants (compare figure 2). In the nearby regions, 85 % of the respondents wish for more information, in the distant regions 75 % do so. The preferred sources of information are (in the sequence of answers) newspapers, community-gazettes, plant-visits, flyers, public information meetings, municipal administration, internet, television and radio.

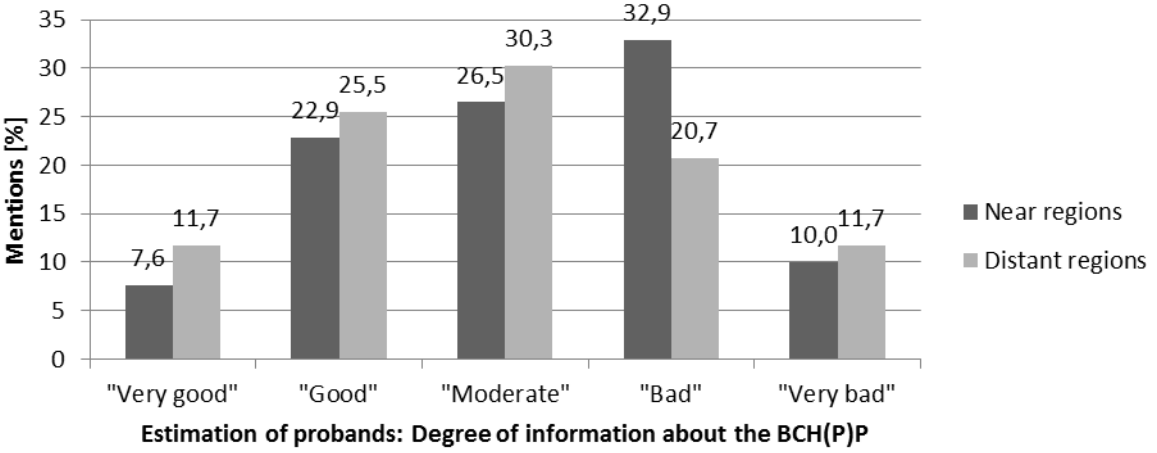

Figure 2."How good do you feel informed about the BCH(P)P in your neighbourhood?" (nNearby regions = 170 / nDistant regions = 145). Own source 2010.

4.3 Which parameters do influence the level of social acceptance?

To identify parameters that have significant influence on the respondents´ acceptance, the answers to the following four questions (which show meaningful results concerning the acceptance of the polled residents) were cross-tabulated with the answers of the interviewees which they gave on various other statements related to their socio demographic characteristics, heat delivery from the BCH(P)P in their neighbourhood, general attitudes concerning environmental issues, their position concerning renewable energies and their degree of information. All in all 116 cross-tabulations were compared with the main results summarized in table I. While the socio-demographic characteristics and the general attitudes on environmental issues did not show a significant influence on the answering of the four questions mentioned below, the fact whether the respondent got heat from the neighbouring plant, his position with respect to renewable energies as well as the degree of information in this field had a significant influence when answering these questions.

1. *„If you think about the plant in your neighbourhood, how is your predominant impression?"*
2. *„Which influence does the BCH(P)P have on the value of your real property?"*
3. *„Presumed you move to another place, would you unconditionally move close (in sight distance) to a BCH(P)P again?"*
4. *„Would you sympathize with a citizens´ initiative who engages against the construction of a further BCH(P)P in your neighbourhood?"*

Table I. Factors with significant impact on social acceptance of BCH(P)P´s in Bavaria. Own source 2010.

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

4.4 Findings from comparisons of selected plant-sites

In a final step, the answers related to selected plant-sites with specific attributes were directly compared with each other. The results of these comparisons show that the size of a plant influences the acceptance of residents. Residents of small plants estimate the influence on their real property value more positively than residents of large plants do, they would in higher percentages move in the neighbourhood of a BCH(P)P again and they would have less sympathy with a citizens´ initiative against an additional BCH(P)P to be built in the region.

In addition to the size of the plant, the factor „time" has an influence on the acceptance of the neighbouring population of a BCH(P)P in a decisive way: A low acceptance in the planning phase of a plant affects future acceptance over years. However, public acceptance seems to tend towards an intermediate level after a longer period of time. This seems to be the case both for plants which experienced a low level of public acceptance during the planning phase as well as for plants which had a high level of acceptance during planning.

5 ACTION RECOMMENDATIONS FOR OPERATORS

The findings of this study were compared with recommendations published in scientific and managerial literature. These comparisons most notably show a necessity for intensive, creative, complex and long-term oriented information and PR activities. This relates both for planned as well as for already established biomass cogeneration heat (and power) plants in order to work against the registered lack of information of neighbouring residents. The following findings constitute this necessity: The average of interviewees of this study only feels moderately informed about the plant, more than 75 % wish more information about the concerned plant, 40 % of the respondents would like to have an abstract with more information about the plant and in addition to that, the degree of information has a significant impact on social acceptance. PR activities related to biomass cogeneration heat (and power) plants should become an integral element of plant project planning and development. The suggested information and PR activities should focus on the potentials of biomass in the heating section and their benefits for environmental- and climate protection, describing the different techniques to use biomass in this area, its advantages with respect to the regional economy and value added, building up a higher level of understanding and problem-orientation of people living in the neighbourhood of such plants, and finally publishing (potential) solutions through established and often-used media (newspapers, community-gazettes, plant-visits, flyers, public information meetings, municipal administration, internet, television and radio). Already in an early stage of the project development of a plant, plant operators should offer plant-visits ("Open day") or roofing ceremonies, publish press releases, organize information panels or co-operate with well-known and trusted persons in the region in order to create a favorable environment for their plants in the population. All in all, it should be taken into account that public acceptance is a credit, which the operating company has to gain through activities with the neighbouring residents, but should not be taken as self-evident!

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