

Article

Bioenergy Villages and Regions in Germany: An Interview Study with Initiators of Communal Bioenergy Projects on the Success Factors for Restructuring the Energy Supply of the Community

André Wüste * and Peter Schmuck

Interdisciplinary Centre of Sustainable Development, University of Göttingen, Goldschmidtstrasse 1, 37077 Göttingen, Germany; E-Mail: peterschmuck@gmx.de

* Author to whom correspondence should be addressed; E-Mail: awueste@gwdg.de;
Tel.: +49-551-39-12585; Fax: +49-551-39-19764.

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Abstract: Because of the serious problems related to an energy supply based mainly on fossil and nuclear fuels, the development of renewable energy sources is urgently needed. In Germany, many villages and communities take energy production into their own hands, following the principle of a community-related energy supply. Today, approximately 50 villages or communities in Germany have restructured their energy consumption patterns to rely primarily on locally available renewable energy sources for their electricity and heat. This article describes a qualitative interview study concerning the success factors for the implementation of bioenergy villages. The interviews were conducted with 25 individuals who initiated the restructuring of energy production in their villages toward bioenergy and other renewable energy sources, such as solar or wind energy.

Keywords: bioenergy village; renewable energy sources; success factors

1. Introduction and Research Questions

Today, the energy supply in most industrial countries is dominated by fossil and nuclear resources. It is well known that the use of these resources is associated with negative consequences for ecosystems and societies.

Burning fossil fuels produces emissions of greenhouse gases. In particular, emissions of carbon dioxide and methane contribute to the natural greenhouse effect, which has well-known consequences for the environment, such as the melting of the ice in the northern hemisphere, the sea-level rise and the thawing of the permafrost soil of tundra and boreal regions. Today, carbon dioxide has a share of 60 % of the anthropogenic greenhouse effect with an upward tendency [1]. Furthermore, deposits of fossil and nuclear fuels are limited and will be depleted within the next hundred years [2]. In 2010, the world population reached 6.8 billion; overall energy consumption was about 15 TW. With a population of over 9 billion by 2050, the overall consumption is likely to exceed 40 TW [3]. Consequently, the rising energy consumption and the scarcity of resources in most countries results in a growing dependence on imports and rising commodity prices in most countries.

Regarding these serious problems, an ecologically, socially, and intergenerationally friendly energy supply can only be achieved with the development of renewable energy sources. Local renewable energy sources diversify the energy supply and contribute to energy import independence and energy security. In addition, renewable energy sources conserve fossil fuel reserves and provide a regional economic development stimulus [4].

In this context, the “bioenergy village” concept, which involves the residents of small towns or villages in planning, funding and implementing the conversion of the energy supply from fossil fuels to biomass, is a great chance to approach sustainable energy scenarios at the community level.

The article examines the success factors and the different pathways concerning the implementation of bioenergy village projects in Germany through a qualitative interview study with project initiators in 25 bioenergy villages. The results are expected to support the transfer of knowledge for further villages in Germany and communities worldwide in restructuring their energy production patterns. In this context, the following research questions will be investigated:

- (1) What are the preconditions and the main motives for the project initiators’ engagement in the bioenergy village project?
- (2) What are the social success factors for implementing a bioenergy village project?
- (3) What are impeding factors for the implementation of a communal bioenergy project?
- (4) What are the consequences after the implementation of the bioenergy project?

2. Bioenergy Villages in Germany

The first bioenergy village in Germany was initiated in 2000 by an interdisciplinary team of scientists at the Interdisciplinary Centre of Sustainable Development (IZNE) of the University of Goettingen. This pilot project was performed as an action research project (for details see Schmuck and Schultz, 2002 [5]) together with the inhabitants of the village, Juehnde, in the south of Lower Saxony. The concept of a bioenergy village aims at converting the electricity and heat supply of a village basing on the renewable energy source biomass. The technical concept of the bioenergy village Juehnde is based on the production of electricity and heat by burning biogas in a combined heat and power station. The electric power is fed into the public grid, and the heat is distributed directly to households by a hot water grid. The peak heat demand in winter is covered by the addition of a wood chip heating plant [6].

In addition to the technical feasibility, an essential part of this project was the “social implementation”, based on the process of creating and fostering the motivation of individuals and groups in the village to participate in such a sustainability project [7]. To achieve broader acceptance and greater willingness to participate, numerous village meetings and information sessions were conducted with the support of the scientists’ team. From the very beginning of the project, the residents of the village were involved in the process of planning and working on the site. Therefore, several working groups were founded by the villagers and were initially moderated by the scientists from the university team. These working groups included, for instance, “agricultural resources”, “heat distribution”, “form of the company to be founded”, “housing technique“, and “public relations” [8]. The results of the groups’ work were integrated and communicated within the village by a central planning group, consisting of the heads of the specific planning groups and local authorities, e.g., the mayor [7].

In the context of this action research project, the scientists performed a longitudinal study to measure the positive psychological consequences of the project. This study noted an increased feeling of togetherness, environmental behavior, self-efficacy, a general well-being and identification of the inhabitants with the village [9].

After the successful implementation of the bioenergy village Juehnde, the district of Goettingen initiated a follow-up project in 2006 to establish more bioenergy villages in the region. Initially, 34 villages within the district expressed interest in a power and heat supply based on biomass. After a selection process and a moderated social implementation in the best-suited villages, another four bioenergy villages in the Goettingen district were realized in 2010 (Barlissen, Reiffenhausen, Krebeck, Wollbrandshausen).

Actually, there are many bioenergy villages in progress. For example, the state of Baden-Wuerttemberg has funded the development of 100 bioenergy villages by 2020, and a campaign in Mecklenburg-Western Pomerania is planning 500 bioenergy villages by 2020 [10,11].

3. Method

3.1. The Problem-Centered Interview

This study focuses on the different pathways through which communal bioenergy projects are realized. For this purpose, an explorative approach was chosen. The problem-centered interview is an established qualitative method for collecting data. The interview is centered on a specific problem, introduced by the interviewer. The crucial part of the problem-centered interview is the guideline. According to Witzel 2000, the guideline is a supporting device to reinforce the interviewer’s memory on the topic of research and provide an orienting framework to ensure comparability of interviews [12].

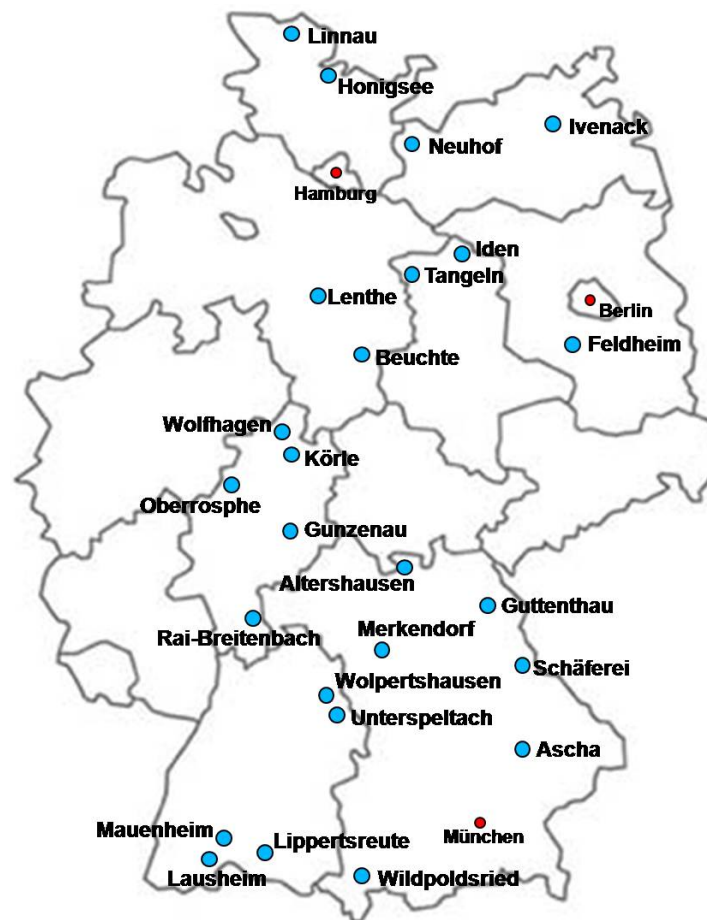
The interview allows the interviewed person to speak as freely as possible without predetermined response alternatives so that an open discussion may arise [13].

3.2. Study Context

The interview study was conducted in 20 bioenergy villages and 5 “integrative” communal bioenergy projects (which combine bioenergy use with other renewable energy sources) between June 2009 and March 2010 (see Figure 1). The 25 investigated communal renewable energy projects were selected

according to two criteria: On the one hand, we wanted to achieve a wide variation over many regions in Germany, to derive representative results from the interviews. On the other hand, the implementation of the projects has to be finished at least one year. The date of the project's realization ranged between the years 1994 (Altershausen) and 2008 (Tangeln). The investigated projects were chosen after an intensive internet and literature search.

Figure 1. Location of the 25 communal renewable energy projects where initiators have been interviewed.



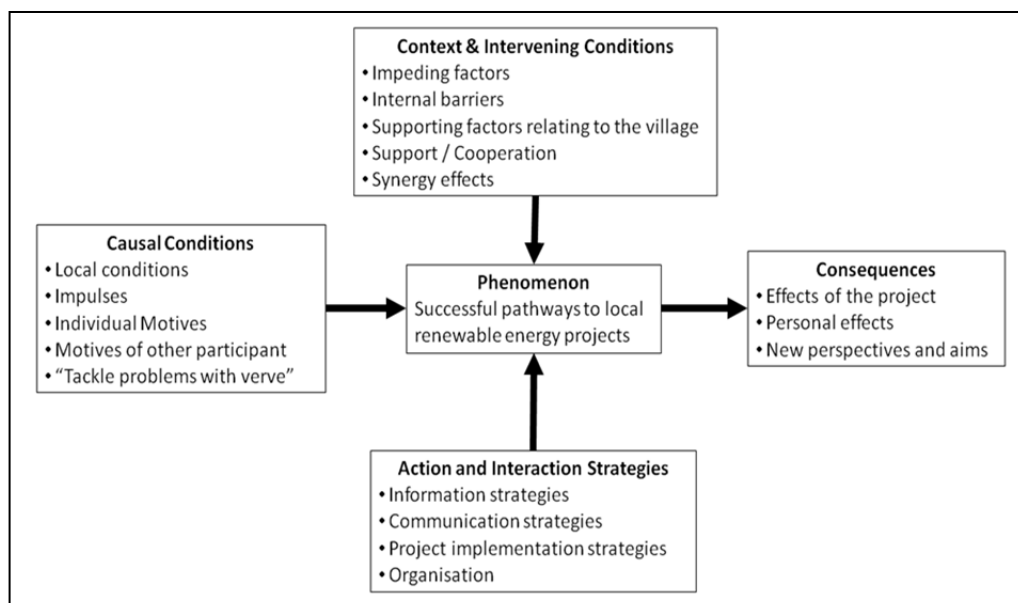
For the interview, one person of each village was contacted, who was substantially involved in the initiation, development and implementation of the projects. Most of the interview partners were farmers or persons engaged in the local politics, such as mayors or volunteers. The interviews took place in the 25 villages, mostly at the interview partners' homes, in town halls or in heating plants.

3.3. Conducting and Analyzing the Interviews

The interviews started in an open manner. The order of most questions of the guideline was flexible. The interviews lasted approximately one hour and were recorded by using a voice recorder. Subsequently, the recorded interviews were transcribed. Following the suggestion of Witzel (2000) [12], the interview transcripts were analyzed referring to the Grounded Theory approach [14]. Hence, the first and the second analyzing step of the open coding and axial coding process were conducted, so that we not used the Grounded Theory approach in its full extension.

Grounded Theory is an inductive method that uses empirical, mostly qualitative data [15]. The central element of the method is the coding process. The coding process started with the open coding, where one or multiple codes (keywords, items) are assigned to a text passage. In a further step, the axial coding, the codes are subsequently linked together and combined into superior categories [15]. It is useful to classify the categories in a coding scheme in order to determine the relationships among them. Strauss and Corbin (1996) proposed a particularly common coding paradigm (see Figure 2) [14].

Figure 2. Paradigm model of the results of the interview study of initiators of renewable energy projects (Referring to Strauss and Corbin, 1996, [14]).



In the centre of this relational structure is the *central phenomenon*, a central idea or event to which different actions and interactions are directed to deal with it. The category *causal conditions* describe all events, which are responsible for the occurrence or the development of the phenomenon. The *context & intervening conditions* characterize properties of the context, relating to the central phenomenon. The category *action and interaction strategies* describe interactions with procedural and goal-oriented characteristic, which act on the central phenomenon. The category *consequences* summarize the intended and unintended consequences, resulting from the central phenomenon [14]. The paradigm model was used to arrange the results of the interviews.

4. Results

The following section describes the results of the interview study. The illustration (Figure 2) of the main categories relates to Strauss and Corbin’s (1996) paradigm model [14].

The following five main categories were formed as causal conditions: local conditions, impulses (trigger), individual motives, motives of other participants and “tackle problems with verve”. In the field of the context and intervening conditions, the main categories were impeding factors, internal barriers, supporting factors, cooperation and support and synergy effects. Concerning the action and interaction strategies, the following main categories were developed: looking for information, information strategies, communication strategies, project implementation strategies and organization.

The consequences were reflected in the subcategories “effects of the project”, “personal effects” and “new perspectives and aims”. These categories are the basis for answering the research questions in the following part. Furthermore, the number of persons is stated, who made a contribution to each category.

4.1. What are the Preconditions and the Main Motives for Project Initiators' Engagement in the Bioenergy Village Project?

The following part describes the local conditions and impulses that are responsible for starting the projects. One precondition, mentioned by 13 persons, is the person of the initiator itself in the function as a driving force. Mostly, the initiators are “well-known” in their village and are characterized as “persevering”. Eight persons mentioned a peaceful coexistence and common activities of the local inhabitants as a further relevant condition for the successful establishment of the project. Some of the interviewees referred to “village festivals” or the high number of “associations” in the village. Three interviewees mentioned the availability of agricultural space and biomass for the energy production as a fundamental requirement for the project to succeed.

The interviewed persons described different impulses as initial sparks for the beginning of the project. Transfer effects from other already established bioenergy villages in Germany, such as the “bioenergy village Juehnde” or the energy-self-sufficient district of “Guessing” in Austria, were mentioned by eight of the interviewees. In these cases, the interview partners or other inhabitants were influenced by the positive effects of these projects and carried these ideas into their own village. Eight of the interviewed persons reported that the impetus to realize a bioenergy village came from the villagers themselves. Generally, an active search for alternatives to fossil or nuclear energy was mentioned by the majority of the interview partners (17 persons). In this context, differences in the motives of the initiators and of the other active participants became apparent.

The motives for the initiators' engagement in the investigated bioenergy villages are multifaceted and mostly determined by a motivation mix. The majority of the interviewed persons mentioned ecological motives (14 persons), such as a “sensible use of the natural resources of the planet” or a “contribution to climate protection”. Some of the interviewees characterized themselves as a “passionate nature lover” or were engaged in the “anti-nuclear movement”.

Twelve persons mentioned economic motives as one reason for their engagement in forming a bioenergy village project. In this context, some of the initiators saw an opportunity to strengthen the “added value in the region”. Furthermore, they wanted to “save costs for heating” or “earn money” with the sale of electric power.

The category “tackle problems with verve” was highlighted by 12 persons. This category describes the endurance and constant efforts toward the creation of a sustainable and local energy supply associated with the improvement of living conditions in the village, culminating in the transformation of the society.

Social motives were mentioned by eight people. Some of these respondents characterized the bioenergy village project as a “community project” and consequently as a chance to “make village life more attractive”. Creating an independent energy supply was also mentioned as a motive by eight of the interview partners. Participants primarily defined energy independence as independence from “fossil fuels” and “big energy companies”. The desire for “self-realization” and the search for

opportunities to “influence” were mentioned by seven persons. Four persons wanted to develop an “alternative source of income.”

4.2. What are the Social Success Factors for the Implementation of a Bioenergy Village Project?

This section describes general success factors and more detailed strategies used by initiators to convince and motivate the villagers to participate in the bioenergy village project.

Constructive cooperation with supporters on different levels was very significant for a successful process. In particular, support from the “local council” and the “mayor” was mentioned by 16 of the interview partners as necessary for a successful implementation of the project. Support from outside the village was also important. Constructive cooperation with the “permit authorities” and the “district administration” were appreciated by nine and seven interviewees, respectively. In some cases, the “federal state government” supported the project (mentioned by 8 persons). Seven of the interviewed initiators perceived the support from different “organizations” as helpful (e.g., an association of co-operatives or the German Biogas Association—“Fachverband Biogas”). Constructive support from “funding bodies” was helpful in seven of the investigated projects, and three interview partners emphasized cooperation with “planning offices”.

Furthermore, the interview partners described supporting factors relating to the village. In ten villages, the initiators identified “open-minded inhabitants”, and in 13 of the villages, they listed “euphoria” as an essential supporting factor in the village. In eleven villages, “synergy effects” were thought to have a positive impact on the acceptance and economic success of the project. For instance, “canal construction” or “road construction works” were planned in some villages so that the installation of the local heating grid could be accomplished in combination with the roadwork.

Furthermore, the interview partners mentioned price fluctuations on the global market as supporting factors (5 persons). These bioenergy villages were developed in a period of “low prices for grain and milk” and an “increased price for oil”.

To inform and motivate people, the initiators applied different information and communication strategies. In all 25 of the examined bioenergy villages, initiators conducted information sessions and village meetings to inform villagers of the current status of the project. In two of the villages, the initiators consulted external, neutral moderators. The visit of already established renewable energy projects was emphasized as a very important success factor by 16 interviewees. For instance, the interviewed persons mentioned in this context “important learning effects” through “personal conversations” with local inhabitants from these best-practice models.

To convince skeptics and opponents, face-to-face conversations were conducted in some of the investigated bioenergy villages (12 persons). A significant contribution was also the conversation and word-of-mouth recommendation between the inhabitants (8 persons). Seven interview partners emphasized the principle of transparency for information and communication processes. In this context, transparency meant that all problems and points of criticism were discussed openly with the local inhabitants. This principle was particularly important for matters relating to “finance and economy”.

During the analysis of the interviews, several project implementation strategies were identified. The majority of the interviewees considered the involvement of the villagers in the planning and implementation processes to be an important step (16 persons). Thus, one or more “working groups”

were founded in some of the villages. Eight interview partners recommended making use of villagers' specific competencies. These competencies were not restricted to the planning process but also extended to the "construction work" to install the heat supply system. In a later phase, it was necessary to involve professional support, e.g., planning offices for a feasibility study (mentioned by 15 persons). Four initiators recommended a cross-party approach. A cross-party approach ensures that the project is not exploited for the interest of only one subgroup of the inhabitants, for instance one specific party.

4.3. What are Impeding Factors for the Implementation of a Communal Bioenergy Project?

In contrast to the success factors, all interview partners also described factors that had a negative effect on the project's development process.

One negative factor was the uncertainty concerning the financing of the project (13 persons). In particular, the acquisition of financial support as funds was described as "very complicated" because of "a long waiting time" or "missing assurances" from funding bodies. Such uncertainty has an impact on the economy of the project. Therefore, some interviewees (3 persons) considered the uncertainty concerning the economy of the whole project and contradictory economic interests (8 persons) to be impeding influence factors. For instance, the interview partners described problems with the "former energy supplier" and the "local fossil oil supplier". Different economic interests with potential biomass providers, such as "forestry" were also mentioned by some of the interview partners.

Furthermore, initiators mentioned the paucity of support from policymakers (12 persons) and administrative bodies (10 persons) as negative factors. Some interviewees described the cooperation with administrative bodies as "difficult" and "slow". In some cases, the political support was "limited" and one bioenergy village project was even considered "undesirable" by the federal state government. Further impeding factors included price fluctuations on the global market. In particular, a "decreasing price for oil" or an "increasing price for grain" reduced the inhabitants' and farmers' willingness to invest in a biogas plant (9 persons).

Furthermore, the interviewees mentioned various internal barriers related to the village and local general conditions. In 16 villages, the initiators had to cope with "doubts" of the villagers. Questions concerning the "costs", "economic efficiency", the "security of the energy supply", and the fear of "smell and noise disturbance" or "risk of accidents" were the main concerns of the local inhabitants. Feelings of envy between some of the villagers were also a problem (7 persons). In some villages, feelings of doubt and envy resulted in a negative propaganda against the bioenergy village project (9 persons). In addition, disinformation (rumors) made the implementation process difficult (3 persons). The use of alternative, individual energy sources such as "wood" or "geothermal energy" in some village houses constituted another obstacle for connecting to the hot water network. These households had no interest in connecting to and investing in a local heating grid (4 persons). In three villages, the "declining population" and the "demographic change" were mentioned as negative factors because the remaining older persons were less interested in investing in the bioenergy village project.

4.4. What are the Consequences after the Implementation of the Bioenergy Project?

This section describes the effects of successful implementation of a bioenergy village project. On an individual level, interviewees mentioned a variety of consequences. On the one hand, 10 interview

partners referred to negative effects on personal life, e.g., less free time for “family” or “hobbies” during the project implementation process.

On the other hand, most of the consequences were positive. The majority of the interviewed partners could accumulate professional knowledge and experience in the field of renewable energy (17 persons). Some of the initiators are now frequently consulted as experts in the development of communal renewable energy projects. They are “often on the way” to “give talks at conferences” or “give a guided tour in the village” to interested people. The development of communal renewable energy projects resulted in a second income for six of the interviewed persons. Furthermore, 14 of the interviewees showed feelings of happiness and a strengthened sense of well-being. Additionally, nine interview partners said that they experienced feelings of pride in the achieved result. Some said that they “had fulfilled their own dreams” or “had a lot of fun” by establishing a bioenergy village. They reported also a higher quality of life resulting from the comfortable energy supply (9 persons). A few interviewees noticed an improvement in their own social skills (3 persons).

Furthermore, the interviewees described consequences at the village and regional level. Nearly all interviewees (22 persons) noticed a higher nationwide publicity for their village. Their villages were visited by “(foreign) tourists”, “students”, “local politicians” and other groups more than they had been previously. In their own region, the bioenergy villages became known as “flagship projects”. Many interviewees noticed an improvement in communal life and a feeling of togetherness in the village (15 persons). These improvements in communal life included, for example, the “integration of new inhabitants” into communal life, “common festivities”, “new acquaintances” or “friendships” and “cross-generational cooperation”. Only two of the initiators noticed no effect on communal life.

Furthermore, the projects significantly contributed to the creation of added value in the region and have had positive economic effects because money for energy stays in the region rather than being paid for imports (12 persons). Furthermore, the “presence of new companies”, the “creation of new jobs” and consequently “new and higher business taxes” are examples of positive economic consequences after the implementation of several bioenergy villages. A further aspect is the local inhabitants’ “identification” with the project (11 persons). Some interviewees mentioned the appreciation of the project and “compliments”, for example, from the villagers or institutions from outside the village such as associations and the federal state government (10 persons). In addition, these bioenergy village projects received awards such as the “German Solar Prize” from the “European Association for Renewable Energy” (EUROSOLAR) or sponsorships from their federal state government. Five interview partners reported positive ecological effects as a result of the project such as “the carbon dioxide reduction”.

Additionally, 23 interview partners described “new goals” and the “further development” of their bioenergy village in the future. The interviewees mentioned, for instance, “the expansion of the local heating grid”, “the implementation of other renewable energies”, “the development of the region to a renewable energy region” and the “construction of charging stations” on the base of renewable energy for electric cars.

5. Conclusions and Recommendations

The motives for the engagement of the initiators in the investigated villages are multifaceted. Using the classification of Stern *et al.* (1993) [16], biocentric motives (ecological reasons) dominated, but

often in connection with other motives, such as anthropocentric motives (social reasons) and egocentric motives. The diversity of initiators' personal motives for the engagement in communal renewable bioenergy projects confirms the findings of Doerner (1999) [17] that a motive mix determines ecologically minded action. The majority of the interviewees intend to protect the climate and nature, to care for the next generations or to create regional value. These experiences are consistent with the findings of an interview study by Eigner-Thiel (2005) on the bioenergy village project in Juehnde. Also, similar experiences in Great Britain show that many of the individuals involved in leading projects concerning locally owned sustainable energy use have been driven by ethical and environmental commitment [18–20].

The reports of increased well-being as a consequence of engaging in the creation of a sustainable energy supply support patterns from questionnaire data that show positive correlations between sustainability life goals and well-being [21]. This data pattern may encourage people who still assume that engaging in new lifestyle patterns may diminish well-being.

Each inhabitant has different reasons for participating in a communal renewable energy project. One successful way to create awareness is to convey a holistic message that the project can achieve a variety of objectives. For example, it is important to emphasize the harmony between environmental protection and the creation of economic value. According to these findings, Jenssen (2011) considered the development of overall concepts as an important element of participation [22].

An early involvement of villagers in the planning and organization process increases the chances of success. The inhabitants can contribute their own competencies and knowledge, and the tasks can be spread across many shoulders. In some of the examined villages, working groups were founded along the lines of the Juehnde model [6,23].

Whitmarsh *et al.* 2011 also recommend an early information and participation process to increase the public acceptance of renewable energy projects. Especially, they emphasize a two-way information exchange, whereby the public not only learns about energy research developments, but also provides answers about the social robustness of technologies and innovations [24].

Congruent with the findings of Eigner-Thiel 2005, interviewees identified face-to-face contacts and personal conversations to mobilize villagers and convince people or skeptics as important success factors. For conveying the initial information about the project, village meetings are suitable. Later in the process, new information and issues that arise during the course of the project can be presented in village meetings.

The principle of transparency is eminently important during the information and communication process. This conforms to the findings of Walker *et al.* 2008, which showed the importance of trust between local people and groups that take projects forward [25]. Also, Zoellner *et al.* 2008 showed that the transparency of the implementation process is relevant. Therefore, citizens are opposed to a realization when they are not involved in the planning and decision-making processes [26].

Another successful way of informing, inspiring and persuading people is to visit well-established model projects. This is consistent with the findings of the bioenergy village project Juehnde (Eigner-Thiel, 2005).

Another very important factor for the implementation of a bioenergy village project is political support. In particular, support from the local council and the mayor is necessary for successful progress. In some cases, the projects were regarded as flagship projects, making it easier to get

subsidies and permission for construction. This is congruent to the findings of Musall and Kuik (2011). He showed that the support and the engagement from the mayor in a small town in East Germany had contributed to the successful realization of a wind farm owned by local citizens [27].

Considering that the initiators and participants in such communal bioenergy projects are working voluntarily (or in an honorary capacity), stronger support from institutionalized advisory bodies (authorizing body) is helpful.

With regard to the projects' consequences for individuals and communities, this interview study confirmed the experiences previously observed in the Juehnde bioenergy village [9,28], but with a much broader empirical base. In the majority of the examined bioenergy villages, an improved sense of togetherness, well-being and identification with the village was observed.

Furthermore, the positive economic effects after the implementation of the projects were also found by Mangoyana (2011). According to his findings, decentralized bioenergy projects have the potential to create employment and the resulting income [29].

6. Outlook

In the context of our ongoing research project, "Sustainable use of bioenergy: bridging climate protection, nature conservation and society", we support the three model districts of Wolfenbuettel, Goslar and the region Hannover on their way to integrative bioenergy regions. In these model regions, we conduct planning workshops with a variety of different actors on a strategic level. Participants include politicians, farmers, mayors, conservationists and people from the district's administration.

In this context, the results (success factors) of the interview study in the 25 communal renewable energy projects were presented in a planning workshop in the district Wolfenbuettel. On the basis of these experiences and the experiences of the bioenergy villages of the Goettingen district, an initiative arose from workshop participants to convince the district government of Wolfenbuettel to provide financial and political support for the development of bioenergy villages in their own district. Regarding the important impact of visiting model projects, politicians from the district have been invited by our team to a best-practice tour to the bioenergy villages Barlissen, Krebeck and Wollbrandshausen in the district Goettingen. As a consequence, the initiative succeeded in securing a fund for starting a bioenergy village support process in the district.

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Conflict of Interest

The authors declare no conflict of interest.

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