EX ANTE ASSESSMENT OF SOCIAL ACCEPTANCE OF SMALL-SCALE AGRO-ENERGY SYSTEM: A CASE STUDY IN SOUTHERN ITALY

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Abstract

Social acceptance is a relevant determinant of the development of agro-energy systems because its absence can cause delays or even the abandonment of innovative projects. This paper aims at an ex ante assessment of the socio-political acceptance of small-scale agro-energy systems in rural areas located in southern Italy, according to the bioenergy village approach. Starting from a theoretical model, we investigated the key factors

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Abbreviations
CD – Coefficient of Determination
CFA - Confirmatory Factorial Analysis
CFI - Comparative Fit Index
EFA - Exploratory Factor Analysis
KMO – Kaiser–Meyer–Olkin
PCA - Principal Component Analysis
RMSEA - Root Mean Square Error of Approximation
SA - Social Acceptance
SD – Standard Deviation
SEM - Structural Equation Modelling
SRMSR - Standardized Root Mean Squared Residual
TLI - Tucker–Lewis Index

influencing the perception of the risks and benefits of the realization of a biomass combustion plant, by a statistical survey on a sample of 152 members of the local community living in eight municipalities located in a rural area. Through exploratory and confirmatory statistical analyses, we identified two key factors: (a) the economic, environmental, and social benefits for the community and (b) reassurance from the energy company management. This research shows that it is very important to consider these elements in order to facilitate dialogue and the debate within the local community. In this way, the involved actors will be enabled to express their expectations to decision makers and policymakers, thus contributing to the steering of the project. In other words, involvement in and the democracy of the energy policy processes are favoured.

Keywords:

agro-energy system; perception; socio-political acceptance; public engagement; structural equation model; rural development.

1. Introduction

The role of social acceptance (SA) is highly relevant in the adoption of innovative projects related to renewable energies. On the one hand, it stands as a characteristic of innovation; hence, it may rouse positive reactions in people who will be eager to realise a technological project. On the other hand, scarce SA may cause the delay or the abandonment of a project because of the direct impact on beneficiaries and the negative externalities affecting society (Gaede and Rowlands, 2018). For instance, the literature refers to atmospheric pollution and public health risks (Upreti and van der Horst, 2004), changes of landscape (Jobert et al., 2007; Carlman, 1988; Wolsink, 1989; Thayer, 1988), and increased local traffic (Bosley and Bosley, 1988). Therefore, correct management of SA may indeed reduce the time between the initial proposal phase of an innovative project and its implementation (Assefa and Frostell, 2007). An in-depth literature review on the definitions of SA will be provided in Section 2.

In this context, the SA is also a relevant determinant for the development of small agro-energy systems, such as the so-called "bioenergy village", which has been experimented with in Austria since the 1980s and in Germany since 2005. In particular, the successful German model (Brohmann et al., 2006; Bohnet, 2013; von Bock und Pulach et al., 2015; Grundmann and Ehlers, 2016) presents a twofold advantage: (a) the small distance among farmers and local households, which may favour the creation of a local energy market that is more environmentally and economically efficient (i.e., by reducing transportation costs), and (b) the municipality scale, which will allow the valorisation of factors that are highly site-specific (e.g., technological characteristics of local biomass or habits and customs affecting economic behaviour of local actors).

The main challenge of this paper was to investigate the mechanisms that may favour the active involvement of stakeholders in rural areas in order to replicate the bioenergy village model in other territorial contexts (i.e., southern Italy).

For this purpose, the methodological approach was aimed at an ex ante assessment of socio-political acceptance, such as the perception of the risks and benefits arising from the adoption of the agro-energy system, and its determinants. In this way, the outcome of the ex ante analysis will contribute to providing science-based arguments to be used in the subsequent political debate among the relevant stakeholders. This process will enable the steering of the project development by the whole community from its early stage. In other words, the identification of eventual critical issues, which may raise the social opposition, will contribute to the development of an adjustment or mitigation strategy by the project promoters. Therefore, the democratic participation of the community members could be favoured, and the customization of the project to the specific local conditions will be pursued.

Specifically, the case study refers to the realization of a small-scale combustion plant fed by agricultural biomass residues (e.g., capacity less than 1 MW) to be replicated in some municipalities located in rural areas (in the Apulia region, southern Italy), with low population density and high potential for biomass availability. These municipalities are part of a sensitive area in terms of SA of renewable energy due to the rapid development of this sector over the last two decades, which in some cases raised the opposition of the local communities.

The methodological approach consists of various steps. Starting from a theoretical model (including the concepts of attitude, perception and socio-political acceptance), we identified and investigated the factors that influence the perception of the risks and benefits of the realization of this plant by statistical survey on a sample of stakeholders belonging to the local community. For decision makers, the key factors (i.e., determinants) of perception are important drivers for the management of socio-political acceptance in their territory.

The novelty and originality of this study is represented by the application, for the first time, of this methodology to the issue of socio-political acceptance of an agro-energy system; therefore, this paper aims at providing new scientific knowledge.

The expected impact is the suggestion of a new approach for researchers, practitioners and designers of small-scale biomass conversion systems that is a combination of top-down and bottom-up governance approaches aimed at improving policies in local administrations and the efficiency of public resource use. Additionally, the paper aims to foster public engagement in the political process.

The structure of the paper consists of the following sections. Section 2 relates to the scientific background and literature review of SA of renewable energy plants, focussing on bioenergy case studies. Section 3 concerns the description of the theoretical model used, the definition of the methodology (i.e., data collection) and the statistical tools. In Section 4, the statistical results are shown and discussed. Finally, policy implications and concluding remarks are reported in the last section.

2. Background and Literature Review

2.1 Definition of SA

To our best knowledge, a univocal conceptualization of SA in the social sciences has not been formulated yet. In the last decade, among the different definitions, Hofinger (2001) stated that it is "the result of an interaction process that takes place in certain contexts and which is interpreted by everyone involved". She proposed seven different modes of acceptance, analysing a biosphere reserve[2] change over the time. According to Langer et al. (2018), this definition contains three elements characterizing SA, such as "thinking (assessments or cognitive component), feeling (emotional relation or affective component) and acting (action tendency or conative component)".

2 . Biosphere reserves, as defined by UNESCO (2017), are areas comprising terrestrial, marine and coastal ecosystems aimed at promoting solutions reconciling the conservation of biodiversity with its sustainable use.

Wüstenhagen et al. (2007) provided another contribution, considering SA in a general context characterized by three different dimensions: socio-political, community and market. *Socio-political acceptance* indicates a general acceptance by the public, key stakeholders and policy actors towards effective policies and technologies. Therefore, its absence could limit the achievement of successful projects at the implementation level (Wüstenhagen et al., 2007; Alasti, 2011; Sovacoll et al. 2012; Langer et al., 2018). *Community acceptance* refers to the specific acceptance by local stakeholders, particularly residents and local authorities. Accordingly, citizens' needs and opinions are key factors in the decision-making process in democratic societies. Thus, when a decision regarding the siting of an innovative technological project is made, residents may raise opposition to this local development due to the well-known Nimby effect (i.e., not in my back yard; Assefa and Frostell, 2007). This type of SA may change according to the phase of the project but also during the same phase, because it is affected by several human parameters (Devine-Wright, 2005). Finally, the third dimension is *market acceptance*, which is based on the economy, where new technologies should be introduced by market players on the supply side and proposed to the demand side. Users do not often immediately recognize the new opportunities created by the introduction of a new technology. Therefore, it is necessary to raise their awareness level regarding the potential application of innovative products and the usefulness in real life (Rogers, 1995).

To date, community acceptance has been analysed the most and, in the Nimby studies (Wolsink, 1994; Wolsink, 2000; van der Horst, 2007; Devine-Wright, 2009), mainly refers to the acceptance of large-scale energy projects. More specifically, the last Italian Nimby report, in 2016, listed several failures that emerged from the construction of industrial plants, including those devoted to energy production from fossil and renewable sources (Nimby Forum, 2017).

In the present paper, the analysis was limited to socio-political acceptance due to the gap in the scientific literature. The motivation underlying this approach relies on the importance of stakeholders' interplay in rural development initiatives and, in particular, in the promotion of innovative projects. In order to activate new initiatives, it is important to achieve a convergence of expectations, which motivates the actors towards a cooperative attitude favouring the concentration and sharing of limited resources, either material (e.g., financial capital and natural resources) and immaterial (e.g., technical knowledge and social capital). In particular, tacit knowledge, which is detained by the local community, is crucial for the valorisation of highly differentiated biomasses in rural areas, for which a consolidated standardized technology or specific expertise is not available (Lopolito et al., 2011; Morone et al., 2012; Sisto et al., 2015; Lopolito et al., 2015).

2.2 Role of SA in renewable energy

The role of SA has been considered by several studies (Ekins, 2004; Zoellner et al., 2008; Kaldellis et al., 2013; Ruggiero et al., 2014; Stigka et al., 2014; Uphama et al., 2015; Yazdanpanah et al., 2015; Jia et al., 2018; Gaede and Rowlands, 2018; Lienert et al., 2018). Most of them reported the factors influencing the acceptance of renewable energy and thus the behaviour of citizens in respect to implementation of new plants, including innovative technologies and infrastructures (Lienert et al., 2018). In addition to these influencing aspects, socio-technical barriers (i.e., organizations, culture, and institutions) also seem to play a significant role in this regard. Specifically, very often they are related with the scarce involvement of influential stakeholders and the low acceptance of residents living close to a place where a plant is sited.

Most academic papers about this topic focus on wind energy (Aitken, 2010; Strazzera et al., 2012; Walter, 2014; Caporale and de Lucia, 2015; Motosu and Maruyama, 2016; Langer et al., 2017; Scherhaufer et al., 2017; Sonnberger and Ruddat, 2017; Langer et al., 2018). This abundance of literature is due to the rapid growth of the share in world gross electricity consumption for wind energy in the last two decades.

Another relevant stream of literature deals with energy from biomass (Madlener and Bachhiesl, 2007; Chin et al., 2014; De Meo et al., 2014; Eswarlal et al., 2014; Kortsch et al., 2015; Longstaff et al., 2015; von Bock und Pulach et al., 2015; Grundmann and Ehlers, 2016; Eaton et al., 2017; Fournis and Fortin, 2017; Giannoccaro et al., 2017; Moula et al., 2017; Van Dael et al., 2017). In this case, the main public concern related to the competition for food versus fuel and the common misconception of people who associate the term *biomass* with *waste*. Currently, SA of bioenergy is affected by low public knowledge of energy conversion technology, compared to solar and wind energy (Van Dael et al., 2017). According to Radics et al. (2016), in the last decade only a few scientific papers have focused on general issues related to public acceptance of bioenergy plants, whereas most contributions have addressed biofuels. The most recurrent factors influencing SA that have been identified through the scientific literature are information about and basic knowledge of various industrial activities, attitude in favour bioenergy, fear about food safety and biodiversity, and willingness to pursue waste minimization and to reduce waste generation.

According to Kortsch et al. (2015), public acceptance of bioenergy plants always remains high over time, but influencing factors differ in their strengths. Specifically, Eswarlal et al. (2014) found that community acceptance of a sustainable small-scale bioenergy project is often affected by local air pollution, inappropriate storage of by-products, trust in the company realizing the plant, and the establishment of a good relationship with the community.

Actually, SA of small-scale agro-energy projects was also evaluated by Rakos (1997) in the late 1980s, when the bioenergy village model was widely implemented in Austria. The model was conceived to valorise local agricultural biomass to satisfy the energy demand of the community. He reported some general evidence that was very similar to that found in the case of other renewable energy projects. In particular, he stressed that the local community had some concerns regarding the actual benefits of the project, the uneven distribution of revenues, and the impacts on the quality of life of the residents (Rakos, 1997, 2003). The consequences, in terms of economic impact of low levels of SA, referred to the increase of project costs, rising up to 30% of the investment (Rakos, 1997). In the case of small-scale projects, local residents face another indirect cost when they refuse to shift their energy procurement from fossil energy to the (cheaper) renewable energy that is produced locally.

3. Methodology and Data

3.1 Theoretical model

In this paper, it is assumed that SA depends on three main factors: knowledge, perception, and fear (Assefa and Frostell, 2007). Among them, the perception of product performance and the opinion on risks of and opportunities from the product's use are by and large the most suitable to be used as a standard method for evaluation of SA (Radics et al., 2015). Starting from this assumption, the ex ante assessment will be focused on the analysis of perception.

The theoretical model is based on the adaptation of that proposed by Van Dael et al. (2017). In particular, the model is based on the definition of *attitude* (i.e., favourable or unfavourable evaluations of a person, group, object or event) from Fabrigar et al. (2005), of *perception* (i.e., acquiring, interpreting, selecting and organising sensory information which has the potential to change perception[3]) from Assefa and Frostell (2007), and of *socio-political acceptance* (i.e., general acceptance by the public, key stakeholders and policy actors of effective policies and technologies) from Wüstenhagen et al. (2007). According to Alasti (2011), perceptions and attitudes (especially the strong and long-lasting ones) affect people's behaviours (i.e., in the case study, the acceptance of small-scale agro-energy systems). In fact, we assume that information is always imperfect, and this generates asymmetry, uncertainty and incomplete knowledge of the world (Kahneman and Tversky, 1979; Simon, 1987). In addition, in the case of innovation diffusion, the decision to adopt or reject an innovation is affected by the information channel reaching the decision maker. For instance, the information is more effective when it is conveyed by a trusted person (Rogers, 1995).

The simplified model that we elaborated on is shown in Figure 1.

Figure 1 illustrates that the information, flowing from outside, raises the factual knowledge of a person, who changes his or her perception towards the agro-energy

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3 Perception can be based on knowledge or a feeling. Feeling, attitude, and belief are taken as different scales of perception.

system. In turn, the new perception determines the intentional behaviour (attitude). Finally, the latter affects the acceptance that is the specific and actual behaviour.

Figure 1. Theoretical model used for ex ante assessment of socio-political acceptance (Source: Adapted from Van Dael et al., 2017)

3.2. Method and data collection

To investigate the factors influencing the perception of the risks and benefits of the realization of the project, a statistical survey on a sample of stakeholders was conducted. The identification of these key factors was based on exploratory and confirmatory statistical analyses (i.e., factor analysis and structural equation modelling [SEM], respectively), based on data collected through questionnaires filled out by stakeholders.

The phases needed to conduct the case study analysis are the following:

First was engagement of the most influential stakeholders, representing consumers, farmers and professionals. The invitation was addressed to the whole community and was promoted by the mayor and a local facilitator, but only a relatively small group of people showed a real interest towards the topic of the research;

Second was the realisation of a public meeting that provides a brief visual presentation to increase factual knowledge. The purpose was to provide the basic scientific knowledge needed to homogenise the terminology and concepts;

Third was collection of information through the distribution of a structured questionnaire, organised in four sections: (a) socio-demographic characteristics, (b) local biomass provision, (c) thermochemical conversion process, and (d) final products and by-products. The first section consisted of open questions, whereas the remaining parts contained closed questions, based on a 5-point Likert scale (1 = *totally disagree*; 5 = *fully agree*). The items corresponding to each question have been identified according to the guidelines of UNEP (2009, 2013) and Diaz-Chavez (2013). In addition, two preliminary tests were conducted by members of the research team (Capuano, 2014; Prosperi, 2014).

Fourth was statistical analysis. The data used for the ex ante assessment were derived by a sample of stakeholders identified in eight representative municipalities of the northern Apulia region (southern Italy; Figure 2), with a total of 152 interviewed people. This area is classified as rural, with low population density and high potential for biomass availability (Table 1).

Figure 2. Location of the municipalities

(Source: our elaboration)

In the last decade, the northern Apulia region has been also affected by the rapid development of a large number of wind farms (Caporale and de Lucia, 2015) and photovoltaic plants. This fast growth of the renewable energy sector caused, in several cases, the opposition of the local communities, which feared the impact on human health, the pollution of the environment, and the worsening of the quality of life. For instance, in the province of Foggia, local communities raised objections against two biomass combustion plants sited in the Sant'Agata di Puglia and Rignano Garganico municipalities. Both are large sized plants and are designed to produce heat and electric power, which is not distributed at the local level. To aggravate the situation, people confused the term *biomass* with *solid urban waste* and the local community lacked involvement in the policy decision making (UNAIS, 2011; Soldo, 2011; Eco della città, 2012; La Gazzetta del Mezzogiorno, 2012; Rutigliano, 2013; Di Munno, 2014a, 2014b; Foggiatoday, 2014, 2015; L'immediato, 2014; Quotidiano di Foggia, 2014; Rignanese, 2015; Statoquotidiano, 2015; Gemma, 2016; Ruberto, 2016; Soldo, 2016).

Therefore, the study area was selected because it is a sensitive area in terms of SA of new agro-energy systems. At present, the municipalities involved in the research are not considering any bioenergy project.

Table 1 – Some information about the municipalities selected for the survey

Source: Adapted from ISTAT demographic census 2011 and ISTAT Agricultural Census 2010

3.3 Statistical analysis

Data analysis was carried out through the following steps:

Step A. Descriptive statistical analysis was used to investigate the socio-demographic characteristics.

Step B. Verification of internal consistency of the measured variables was done using the Cronbach's alpha (α) coefficient (Gliem and Gliem, 2003) ($\alpha \geq 0.9$: excellent; $0.7 \leq \alpha < 0.9$: good; $0.6 \leq \alpha < 0.7$: acceptable; $0.5 \leq \alpha < 0.6$: poor; $\alpha < 0.5$: unacceptable). In this way, it was possible to check whether the respondents paid attention to the question and did not reply accidentally. In fact, in the case of non-correlation of items, it will not be possible to find the latent variables underlying them in the next step.

Step C. Exploratory factor analysis (EFA) was used to investigate which latent variables influenced the measured items concerning the perception of an agro-energy system. In order to verify if the survey data were suitable for factor analysis, the Bartlett sphericity test and the Kaiser–Meyer–Olkin (KMO) suitability test were conducted. The Bartlett test verifies variables' correlations and indicates that factor analysis is useful when $p < 0.05$. Additionally, the KMO test measures the proportion of variance in variables that might be caused by underlying factors ($0.5 \leq \text{KMO} \leq 0.7$ is acceptable; $0.7 < \text{KMO} \leq 0.8$ is good; $0.8 < \text{KMO} \leq 0.9$ is great; $\text{KMO} > 0.9$ is superb). In this study, the EFA was performed by means of principal component analysis (PCA) to minimize the loss of information and achieve a minimum number of factors. In order to guarantee the independence among the factors, the varimax method was used for orthogonal rotation. We chose 0.45 as the minimum value for the factor loading.

Step D. Confirmatory factorial analysis (CFA) was applied to test the validity of the resulting latent variables and to remove insignificant items by means of SEM. SEM produces path diagrams (Figure 3) that consist of rectangles for observed variables (items, in this case), ellipses for latent variables, curves with arrowheads on both sides for correlations and straight lines with arrowheads on one end as path directions, which link a latent variable and an item. The numbers over the paths are the standardized path coefficients, which are the same as the beta weights in a multiple regression. They show the direct effect of a latent variable on an item in the path model. The numbers placed outside the rectangles indicate the residual error of each item, also called disturbance terms. This reflects the unexplained variance. The numbers near the curved arrows are the correlations among the latent variables.

Step E. Evaluation of SEM results was done by means of goodness of fit indices and validity indices (Schumacker and Lomax, 2010). The indices of goodness of fit are the following: (a) χ^2 for goodness-of-fit of the SEM model (good fit for $p > 0.05$); (b) root mean square error of approximation (good fit for RMSEA < 0.10); (c) Tucker–Lewis index (good fit for TLI > 0.95); (d) standardized root mean squared residual (adequate for SRSR < 0.05). The indices of validity are the following: (a) coefficient of determination (CD; similar to the R-squared value, ranging 0–1) and (b) comparative fit index (good fit for CFI > 0.95).

4. Results and discussion

4.1 Statistical results

The sample in Step A consisted of 152 people belonging to three categories, such as consumers, farmers, and professionals. They are represented by 112 men and 40 women. Therefore, it seems that the technical nature of the discussion is less attractive to women. By exploring the composition of the sample in terms of the type of stakeholders, it emerged that most of the women were concentrated in the consumer group, whereas only a few of them were in the other two categories (Table 2).

The mean age was 44.38 ± 13.14 SD (range 18–74), and the average number of family members was 3.29 ± 1.25 SD (range 1–9).

The spatial distribution across all municipalities is shown in Table 3. In general, there are medium-size groups, with a range 11–30 people, and on average 19 people per group. The size of the groups was sufficient to engage people in an open discussion at the end of the visual presentation to provide some non-technical additional explanation.

Table 2 - Socio-demographic characteristics

Table 3 – Distribution of the sample across municipalities

The educational backgrounds of participants was related to the age. As shown in Table 4, people with low education were less represented due to the (relative) complexity of the topic. On the contrary, a greater number of people had obtained high school diplomas and bachelor degrees.

Table 4 – Educational background of participants

Concerning Step B, the internal consistency of the measured variables considering the Cronbach's alpha coefficient was good ($\alpha = 0.869$), therefore the items have shared covariance and they probably measure the same underlying concepts. In other words, the result proves that a correlation of items exists, and it was possible to find the latent variables underlying them in the next step.

The 14 items of the questionnaire in Step C were submitted to EFA. The KMO index was 0.92; furthermore, the Bartlett sphericity test was statistically significant ($p < 0.001$). Therefore, the data were considered suitable for EFA. PCA with varimax rotation was conducted and revealed the presence of three factors. The factor loadings are shown in the last columns of Table 5.

The CFA for Step D was conducted by means of an SEM to test the validity of the resulting latent factors, allowing the removal of the insignificant items from the initial 14 to the final 11. The model is shown in Figure 3. The identified CFA model is characterized by two latent factors which, according to their relations with the items, have been labelled respectively *Benefits* (i.e., economic-environmental and social benefits for the community) and *Reassurances* (i.e., reassurance from the energy company management), characterised overall by 11 items. The third latent factor identified by EFA and some items were removed. In particular, SEM analysis detected a significant influence of Benefits on C, D, J, K, L, M, and N and of Reassurances on C, F, G, H, I, and N, respectively (Table 5). It is worth mentioning that two items affected both latent factors; that is, C (biomass provision contracts) and N (disclosure of company data regarding feedstock, emissions and energy production). The number on curved lines was 0.095 (Figure 3), meaning that Benefits was almost completely independent from Reassurances. The signs of path coefficients were all positive, meaning that a directly proportional relationship exists between the factors and the items.

Table 5 - Descriptive statistics and EFA: factor loadings, variance and percent of variance

Note. Interviewees answered using a Likert scale from 1 (*total disagreement*) to 5 (*full agreement*). (a) factor loadings smaller than 0.45.

Figure 3. Two latent factors of the 11 items.

Fit indices for the SEM evaluation in Step E are shown in Table 6. Each indicates a good fit. Specifically, χ^2 is not significant ($p > 0.05$), RMSEA is lower than 0.10, TLI is higher than 0.95, and SRSR is lower than 0.05. Additionally, indices of validity confirm an excellent evaluation of the SEM model. CD is very close to 1 and CFI is higher than 0.95. Therefore, the fitness and validity indices prove the existence of two strong factors underlying the investigated items.

Table 6 - Fitness and validity indices for the SEM evaluation

4.2 Discussion

The statistical analysis has referred to the theoretical model described in Section 3.1, which was adapted to the specific case study, and where the emphasis was given to the stakeholders' perception. In this way, it was possible to perform the ex ante analysis, which had the aim of understanding the determinants of SA at the early stage of the project.

In general, the stakeholders expressed a very high level of satisfaction, as indicated by the high score values of the different items. This implies that the general concept of a small-scale agro-energy system is accepted, so long as public events are organised and participants are enabled to express their opinions and feelings. Therefore, the idea of converting agricultural residues collected in the area into energy for satisfying local needs is perceived as an opportunity to be explored.

Concerning the scientific findings that emerged from the application of the theoretical model, two determinants are able to influence the socio-political acceptance of a small-scale agro-energy system: (a) economic, environmental, and social benefits for the community (i.e., Benefits) and (b) reassurance from the energy company management (i.e., Reassurances). This means that the intentional behaviour of local stakeholders will be strongly affected by these aspects.

4.2.1 Economic, environmental, and social benefits for the community.

Stakeholders pay attention to the fact that the establishing of supply contracts may guarantee an additional income to local farmers (item C; Table 5). In this way, they may contribute to the economic development of their territory (item D), towards the achievement of energy self-sufficiency (item K). It is acknowledged that the sustainability improvement will foster a green reputation (item J) of the municipality. In addition, establishing formal contracts with local firms that accept the ashes produced by the biomass combustion process is positively perceived, because it will guarantee a better quality of life and health conditions to citizens (item L). Citizens' expectations of a reduction of taxes and energy costs, due (at least partially) to satisfying the local energy demand (item M), certainly play an influential role. Finally, a relevant role is attributed to the company management, whose efforts to provide information and communication regarding the raw material used, the polluting emissions and the amount of produced energy will contribute to increasing the level of mutual trust (item N).

4.2.2 Reassurance from the energy company management. It is worth mentioning that for the Reassurances latent factor, items C and N are also topics affecting stakeholder' perceptions, but in this case they may reflect another aspects. Firstly, the establishment of contracts with local farmers will ensure the provision of biomass, which is locally available. Therefore, the company will avoid the use of feedstock from unknown origin and retain the value added at the local level (item C). Regarding the second common item

(N), the company management, through providing information and communication, will contribute to increasing the level of mutual trust.

Other aspects are related to some technical issues, which are perceived as relevant to the local context. The adoption of an innovative smoke filtration system may guarantee the minimisation of emissions and preservation of quality of life and citizens' health (item F). The use of see-through deck railing around the biomass plant area will strengthen the trust in the company, because it enables the community to control the type of biomass (item G). More specifically, the obligation to use only wood biomass will strengthen the trust in the company (item H). Finally, the existence of a monitoring committee made up of citizen representatives will be a factor that further increases the trust in the company (item I).

According to the obtained results, it is evident that the critical issue is represented by the stipulation of an optimal biomass provision contract between farmers and the energy company. The challenge is to reach an agreement capable of pursuing the economic, environmental, and social benefits for the community (e.g., biomass price, discounted price for green energy supply, reduction of emissions, and jobs), with reassurances from the company management (e.g., commitment to using only local agricultural residues and commitment to adopting the best available technology for pollution abatement).

5. Conclusions and Policy Implications

The research shows that although the population is apparently in favour of the proposed vision of implementing a small-scale agro-energy system, expressed by a very high positive score in the questionnaire responses, it cannot be presumed that the acceptance is not undermined by concerns about the perceived benefits and the reassurances regarding possible risk to health and quality of life. These aspects, if neglected, could lead to problems of socio-political acceptance and might cause serious consequences on the development of the project. In this way, a high level of interest will be expected by the actors involved, who will be able to express their expectations, thus succeeding in contributing to the steering of the project. In other words, community involvement and the democracy of the processes are favoured.

The research confirms the findings that emerged from the research of Rakos, who had highlighted the crucial issues that created distrust in the Austrian populations of the 1980s and 1990s, when the first bioenergy villages were built in rural areas. In this regard, Rakos (2003) stated:

> A major barrier to the establishment of BMDH [Biomass District Heating] plants has been initial misgivings about the new technology (this was especially true of the first villages to convert to the system). Will it work? What will be its impact on village life? Who is going to profit from the project? These were some of the questions discussed at length at the village inns. There seems to be no way of avoiding this distrust of new technology. It is an anthropological constant, present regardless of the type of innovation and the specific cultural context. Mistrust of unfamiliar innovations plays a central role in the cultural integrity of a society. This form of distrust is not only an individual phenomenon; it is also a social one. Rational economic and technical considerations will only serve to create trust if they both symbolically and factually converge with the social meaning accepted by the majority of the society affected. (p. 311)

In rural development, where it is fundamentally the collaboration among key stakeholders that provides production input (scarce and scattered) and tacit knowledge, the ex ante assessment of socio-political acceptance becomes crucial for effective management of a small-scale agro-energy project. In this way, it is actually possible to reduce the probability of delays during the stages of advanced development or even the abandonment of the project, determining its failure. By decreasing the probability of local community opposition, the risk of investment is also reduced and greater attractiveness is generated for financiers. Consequently, in public tenders aimed at fostering renewable energy production, in addition to the business plan, the roles of socio-political acceptance analysis and of measures for mitigating and adapting to the project impacts (social, economic, and environmental) must be envisaged, including a contingency plan for possible risks of social opposition.

Besides the professional designers of agro-energy systems and project promoters (often represented by local political subjects such as mayors and members of the municipality board), other professional categories must be involved in the development process of the project, such as economists, rural sociologists and communication experts. In fact, the latter category is very important to promoting informative campaigns that should be well oriented to widening and encouraging debate favouring public engagement. This implies a change of paradigm towards a multidisciplinary approach capable of capturing the multifaceted nature of the socio-political acceptance of a local agro-energy system.

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Table 1-revised

Municipality	**Population**	**Energy demand (10^3 EUR)**	**Farmland (ha)**	**Biomass (10^3 EUR)**
Apricena	13,287	30,000	13,071	504
Ascoli Satriano	6,288	15,000	25,024	1,408
Carpino	4,139	7,000	6,536	2,755
Corato	48,339	125,000	11,692	3,110
Lucera	33,898	71,000	31,775	2,192
Orsara	2,767	5,000	5,011	423
Stornarella	5,388	12,000	6,521	301
Volturino	1,712	5,000	6,402	193

Table 2

Typology of stakeholders	Frequency	Percentage
Citizen/Consumer	101	66.45
female	*35*	
male	*66*	
Farmer	25	16.45
female	*2*	
male	*23*	
Professional	26	17.10
female	*3*	
male	*23*	
Total	152	100.00

Table 3

Municipality	**Frequency**	**Percentage**
Apricena	26	17.11
Ascoli Satriano	12	7.89
Carpino	19	12.50
Corato	27	17.76
Lucera	11	7.24
Orsara	12	7.89
Stornarella	30	19.74
Volturino	15	9.87
Total	152	100.00

Table 4

Education	Frequency	Percentage
Middle school	14	9.27
High school	75	49.67
Bachlor degree	43	28.48
Master or Doctorate	19	12.58
Missing value	1	
Total	***152***	100.00

Table 5

Id item	ITEMS	Descriptive statistics			EFA		
		mean	SD	n	Factor loadings		
					1	2	3
A	How much do you know about the energy characteristics of pruning residues?	3.25	1.15	151	(a)	(a)	(a)
B	Would you be in favour of setting up a plant in your area that would enhance pruning residues?	4.16	0.96	147	(a)	(a)	0.5818
C	Could supply contracts with the biomass plant be useful to local farmers?	4.16	0.87	144	0.5217	0.4692	0.5050
D	How much can the opportunity for farmers to obtain revenues from the sale of pruning residues and for local companies to take care of their harvesting and crushing contribute to local economic development?	3.94	1.10	142	0.7013	(a)	(a)
E	How much can the lack of burning pruning residues on the fields contribute to the health and safety of citizens?	4.20	0.84	142	(a)	(a)	(a)
F	Can the presence of a highly innovative smoke filtration system in the biomass plant for minimizing emissions guarantee life quality and citizen health?	4.10	1.01	143	(a)	0.6148	(a)
G	Would the choice to use see through deck railing, in order to allow the visibility of the stored and used raw material from outside, strengthen the trust in the company?	3.99	1.03	142	(a)	0.6112	(a)
H	Would the obligation of using only wood biomass strengthen the trust in the company?	4.02	0.96	138	(a)	0.6961	(a)
I	Can the presence of a monitoring committee, made up	4.26	0.93	146	(a)	0.4720	(a)

	of representatives of citizenship, be a factor of greater guarantee towards the company?						
J	Can the recognition of municipality as "green", i.e. producing renewable energy, contribute to local development?	4.18	0.93	148	0.7726	(a)	(a)
K	How much important is the possibility for your municipality to achieve greater energy self-sufficiency with this initiative?	4.02	0.93	145	0.8020	(a)	(a)
L	If there were contracts with local companies for the disposal of ashes, how much would be the level of life quality citizen and health guaranteed?	3.93	0.96	138	0.6447	(a)	(a)
M	How much relevant are the benefits for the community arising from the reduction of taxes and energy costs?	4.22	0.90	147	0.6500	(a)	(a)
N	If the company management policy envisaged to communicate yearly the quantity of raw material used, the polluting emissions and the energy produced, would confidence be increased towards its activity?	4.15	0.98	145	0.6068	0.5076	(a)
	Variance				3.929	2.516	1.094
	% Variances				0.538	0.345	0.1498

Note: the interviewed person answered by a likert scale, from 1 (total disagreement) to 5 (full agreement). (a) means that *factor loadings are smaller than 0.4*

Table 6

Fit indices	Values
Chi Square Goodness of Fit	χ^2=50.224 df=41; p>0.05
RMSEA	0.049
TLI	0.978
SRSR	0.041
Validity indices	
CD	0.966
CFI	0.984

Figure 1

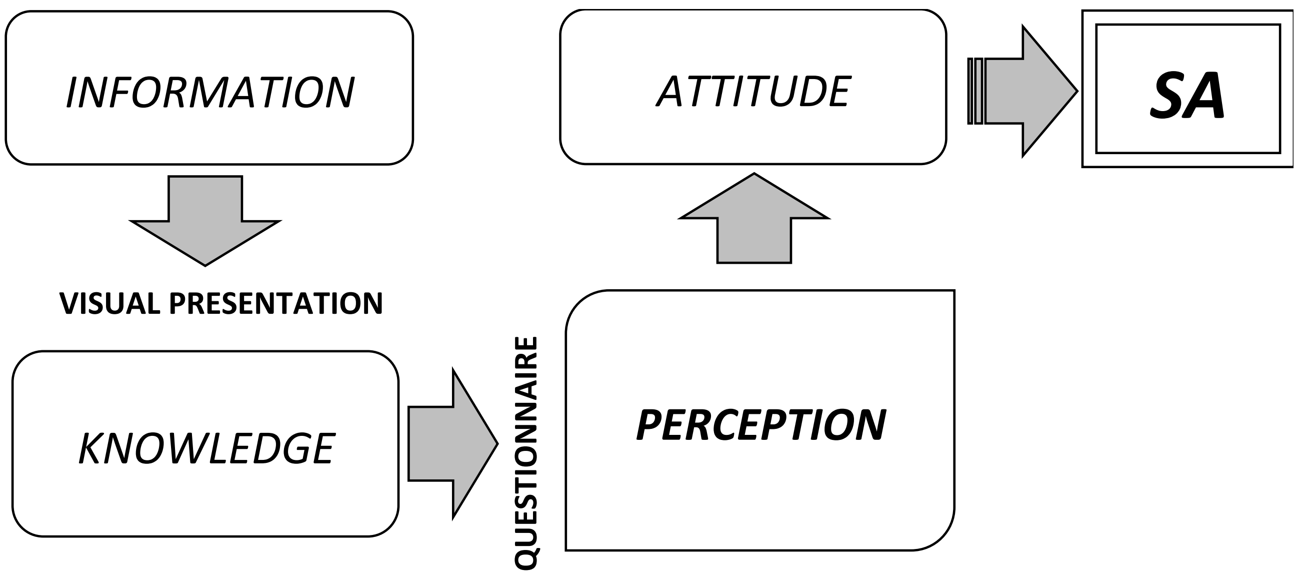
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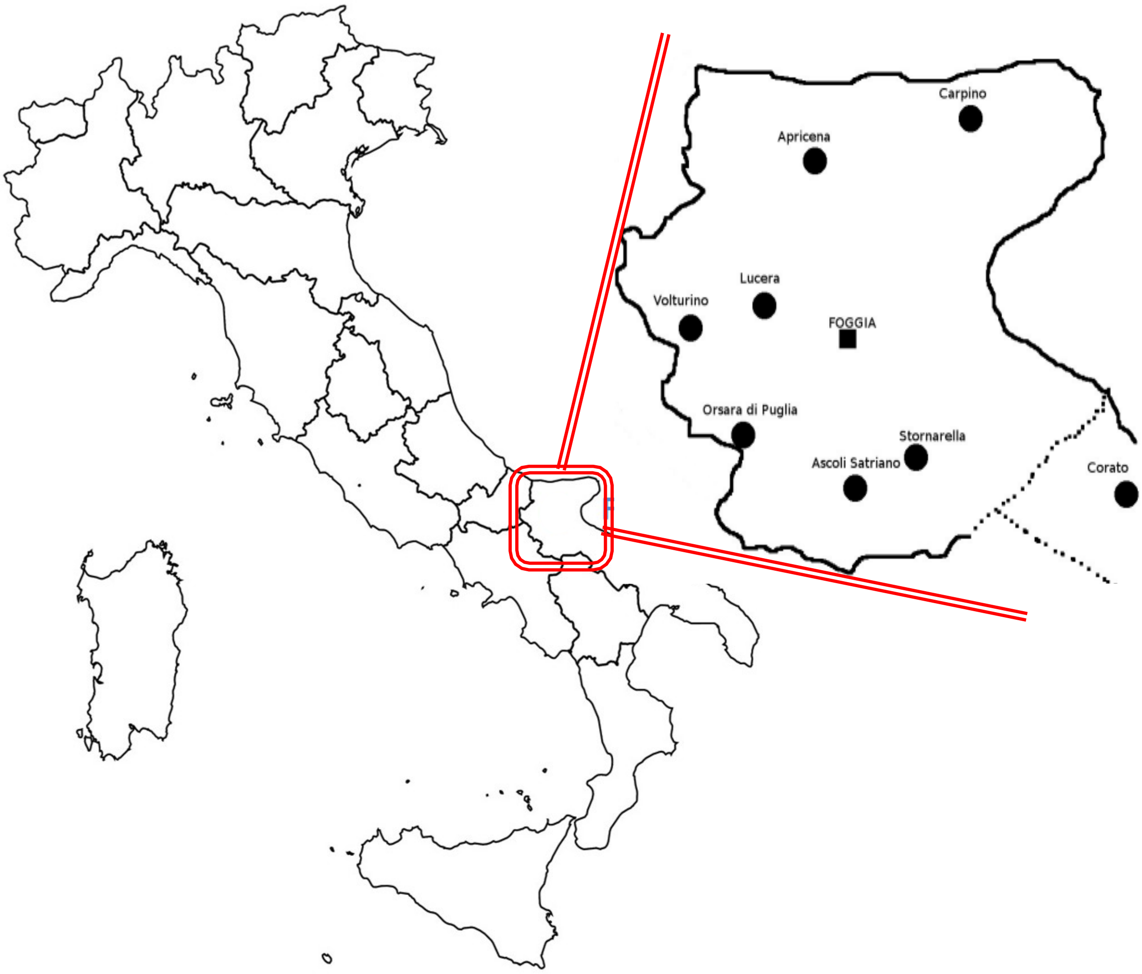
Figure 2



Carpino
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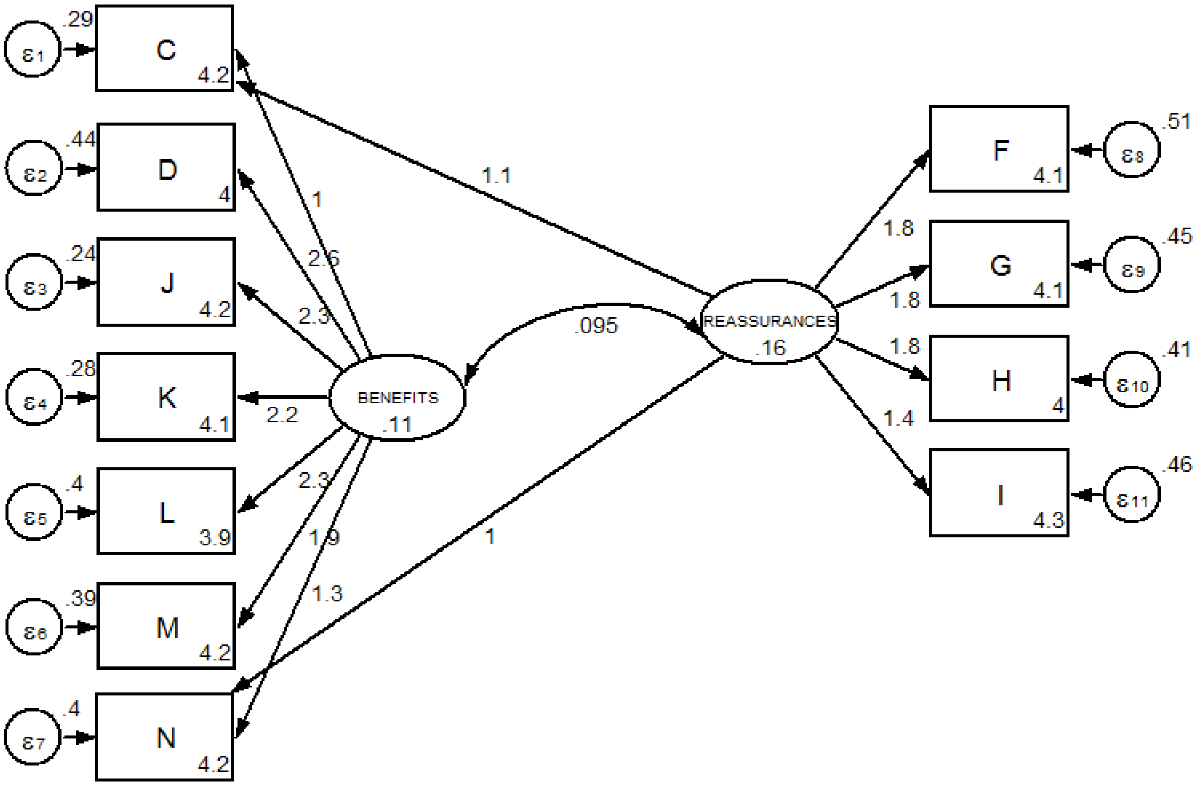
FOGGIA
Orsara di Puglia
Stornarella
Ascoli Satriano
Corato

Figure 3



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