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Perceptions of local population on the impacts of substitution of fossil energies by renewables: A case study applied to a Spanish rural area

P. Gargallo, N. García-Casarejos*, M. Salvador

Faculty of Economic and Business, University of Zaragoza, 50005, Spain

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Abstract

Using the perceptions of a sample of 231 people from a Spanish region as a case study, this paper aims to respond to the increasing demand for measurement of economic, social and environmental performance of renewables implementation. First, from this information, the paper analyzes the willingness to pay of the rural community for the complete replacement of fossil fuels with clean ones throughout the region. Second, it explores this rural community's perceptions in order to determine the most outstanding outputs, outcomes and impacts for the whole renewable energy penetration.

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Keywords: Impact; Output; Outcome; Perception; Renewable; Willingness to pay

1. Introduction

There is an extensive literature on the nexus between energy consumption and economic growth (see [1]). Conventionally, coal, natural gas and petroleum are the more effective and prominent sources of energy, and therefore, they are considered as the drivers of economic growth [2]. Nevertheless, this dependence on traditional energy sources has also created the issues of energy poverty, volatility in energy prices, and rise in carbon emissions [3,4]. These issues have needed that societies and institutions discover alternate sources of energy in order to replace traditional nonrenewable energy sources [5].

The importance of renewable energy sources has grown all around the world due to their positive impact on environmental quality and to the encouraging sustainable economic development. Concretely, renewable energy not only is useful for decreasing dependence on conventional fossil fuel-based energy but also for improving energy security, mitigating carbon emissions, protecting the climate, combating global warming and sustaining the environmental quality [6].

The International Renewable Energy Agency [7] has developed an optimistic scenario, according to which, electricity generation from renewable energy is expected to rise from 25% in 2017 to 85% in 2050. Unfortunately,

* Corresponding author.

E-mail address: ngarcia@unizar.es (N. García-Casarejos).

progress to increase renewable energy capacity is being slow, due to a range of technical, economic and social factors where one of them is the public opposition to proposed renewable energy developments. The most commonly cited reasons are: an inadequate scale of development, an unacceptably high relation between costs and local benefits, and a lack of adequate communication and consultation of local residents by developers [8–11]. In this sense, Yuan et al. [12] highlighted a lack of information in residents of rural, suburban, and urban areas in China. Another study on the opinions and perceptions of the local population regarding solar energy and the installation of photovoltaic systems was carried out by Muhammad-Sukki et al. [13] in Malaysia. This research concluded that Malaysians were reluctant to invest in photovoltaic energy because they barely understood its incentives and its socioeconomic benefits.

Apart from social acceptance, many studies focus on the economic amount that a consumer is willing to pay for further expansion of renewables in their area of residence. For estimation of the economic value that an individual hypothetically assigns to renewables, the most commonly method used is the contingent valuation [14] which results are obtained usually through surveys. Some studies have already identified a positive relation between willingness to pay, income and level of information [15]. Dalton et al. [16] examined the attitudes towards renewables from Australian tourists and the authors observed that they were willing to pay 1–5% more for the existence of renewable energy systems within their accommodations. Ek [17], by means of the statistical technique of binary logistic regression, found that people from Sweden with increased environmental awareness are more likely to accept renewable energy. Similar results were obtained in a study of willingness to pay for green electricity among Swedish consumers [18]. This paper concluded that a proactive attitude towards environmental issues lead to a higher level of economic commitment.

Del Río and Burguillo [19] shown that acceptance or rejection of a renewable project by the local population can make its implementation and its contribution to local sustainability a success or a failure. In turn, the greater the benefits for local communities, the greater are the possibilities of social acceptance and success of the project. In the end, support for renewable energies will depend to a large extent on the perception of their benefits at territorial/local level. Within this context, small rural areas can serve as a demonstrative example to assess the willingness of its inhabitants to implement renewables and to know their perceived benefits in the short, medium and long term. Therefore, the objective of this paper is to address the economic, social and environmental dimensions of the positive effects of replacing fossil fuels with renewable energies throughout the rural region of Somontano-Barbastro (Spain), with two objectives: (a) analyze the willingness to pay of its inhabitants and (b) explore the perceptions of the rural community about the most outstanding outputs, outcomes and impacts.

2. Renewable energy and rural areas

In this section, we briefly analyze the link between renewable energy and rural areas. Renewable energy is being championed as a potentially significant new source of jobs and rural growth in OECD countries, and a mean of addressing environmental and energy security concerns. At present, rural areas occupy 90% of European Union territory and contain 57.4% of its population, playing a determinant role in sustainable development [20]. In this context, the need for tackling climate change and CO₂ emissions provides ever increasing challenges, namely the possibilities to explore endogenous energy potential [21]. While cities demonstrate an ever-growing pattern of energy consumption, rural areas keep themselves as almost low-density territories and with the greatest potential of renewable energy sources.

In most countries, governments have invested large amounts of public money to support renewables development. Rural areas attract a large part of investment related to renewable energy deployment, tending to be sparsely populated but with abundant sources of renewables. But what does renewable energy offer rural areas? What are the social, environmental and economic impacts of these policies and investments? Can renewables really help to develop rural economies? Clean energy indeed represents an opportunity for stimulating economic growth in hosting communities? These are some of the questions that are currently trying be answered.

The delimitation of infrastructure areas associated with renewable energy production has enabled an understanding of the changes in land occupation and the emergence of a functional dichotomy between the preservation of lands with strong agricultural potential and the massive expansion of renewable energy production across rural areas. This allows us to understand how the implementation of renewable energy sources is ever more linked to the local decision-making process associated with spatial planning. The role that municipalities can play in the definition of strategies to ensure an efficient, balanced and sustainable renewable energy zoning in rural areas will therefore be

crucial. It is well commented in the literature that the renewables deployment can provide hosting communities with some benefits such as inclusion of new revenue sources for land owners, innovations in products, capacity building and community empowerment and an affordable energy.

Within the urgent challenge to reinvent, rethink and rebuild territories according to a process of adaptation to energy descent, it is thus essential to understand the key role that rural areas can actually play, paving the way forward for this transition. Indeed, the organizational model of rural areas that has always been based on the three pillars: 1. Production of food — main function, 2. Agriculture — main economic activity, 3. Balance between natural features and human activities carried out — form of landscape is inevitably changing. In this context, the implementation of renewable energy sources is a new aspect of development which may improve and enhance the competitiveness, specialization and economic growth of rural areas. In a future scenario where fossil will no longer be able to ensure global energy supply, there will have to be a sustainable renewable energy sources mix embedded within rural areas.

This could mean a new smart specialization of rural areas as green energy exporters to fuel urban areas, constituting a fourth pillar within the organizational model of rural areas. This fourth pillar of rural areas should provide effective and long-lasting answers to climate change. Nevertheless, the implementation of renewable energy sources requires a balance between occupation and land use, at the same time, preservation and respect for the environmental, cultural and scenic values of these privileged territories.

In order to implement this fourth pillar in a successful way, it is necessary that the inhabitants of rural communities were willing to specialize in producing green energy. Therefore, knowing the opinion, attitude and disposition of rural population to implement renewables becomes a key aspect. Within this research framework, the two aims of this study are (a) the analysis of willingness to pay of a Spanish rural community for sustainable proposal of 100% substitution of the fossil fuel with renewables in its whole region, and (b) the study of the rural community's perceptions in order to determine the most outstanding outputs, outcomes and impacts for the whole transformation to renewable energy.

3. Methodology

A survey among the inhabitants of the Spanish rural area Somontano-Barbastro was carried out. This survey was used to build a comprehensive picture of local public opinions about the environmental, social and economic effects related to renewables. The definitive questionnaire includes variables related to the attitude towards recycling, water and energy savings measures, interest on renewables, negative externalities of fossil fuels, short, medium and long terms benefits of implementing renewable energies in the region, etc. Data was collected in April 2017. The method of random stratified sampling at municipality level was used. The size of the sample was 231 respondents. The questionnaire was responded by people from different strata of age and activity: students, employed and self-employed workers, homemakers and businesspersons. The respondents were chosen at random, in different public places, close to a high school, industrial parks, civic centers and main commercial streets. Therefore they did not have any previous information about the subject related with the survey however they gave their written informed consent to be included in the study.

A descriptive analysis of the total sample was made. The qualitative variables are expressed by indicating absolute frequencies and the equivalent proportion of each of the categories, and quantitative variables with their means and standard deviations. The relationship between variables was analyzed by means of appropriate contrasts of hypothesis (t-test and ANOVA) and error bar graphs.

4. Results

Somontano-Barbastro is a rural region situated in the northeast part of Spain (see Fig. 1) with 29 municipalities that contain a population of 24,111 inhabitants in an area of 1163 km². The region, in the foothills of the pre-Pyrenean mountain ranges, is varied in landscapes, rich in history and cultural heritage, as well as being a paradise for lovers of adventure and nature. Thanks to all this, Somontano has become one of the most important tourist destinations in Aragon and can be enjoyed throughout the seasons. It is a generous land with suitable climatic conditions for the development of an agriculture that obtains excellent oils, vegetables and famous wines with the seal of the Denomination of Origin “Somontano”.

Table 1 shows that 66.2% of the respondents are women, 47.6% have secondary studies and 35.9% have university studies. Regarding the willingness to pay, the most important category is composed by the respondents who are

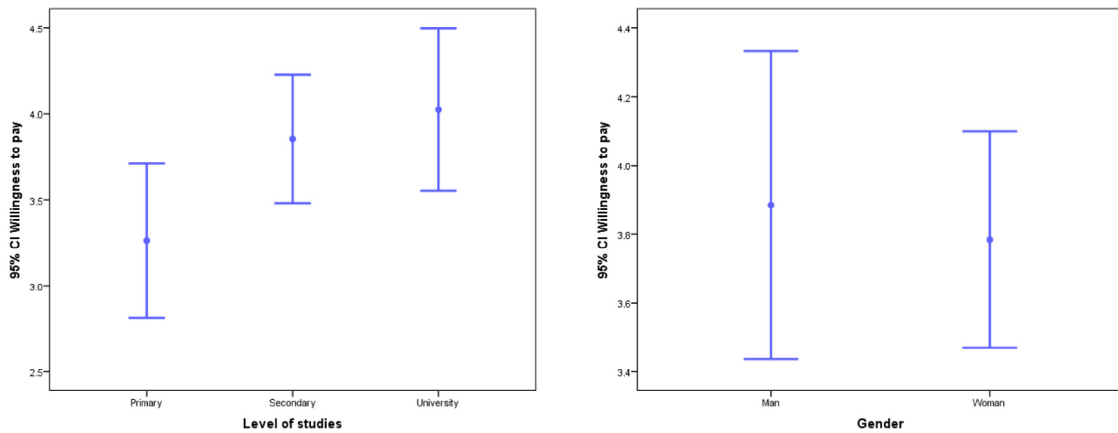


Fig. 1. Willingness to pay with respect to level of studies and gender.

Table 1. Descriptive study of the some characteristics of the respondents.

Sex	Frequency	%	Level of studies	Frequency	%
Men	78	33.8	Primary	38	16.5
Women	153	66.2	Secondary	110	47.6
			University	83	35.9

Table 2. Descriptive study of the some characteristics of the respondents.

Willingness to pay	Frequency	%
Up to 50€	26	11.3
From 50€ to 100€	41	17.7
From 100€ to 500€	56	24.2
From 500€ to 1000€	31	13.4
From 1000€ to 1500€	20	8.7
From 1500€ to 2000€	17	7.4
Over 2000€	40	17.3

willing to pay between €100 and €500. Surprisingly, more than 17% are willing to pay more than €2000, which is the equivalent of more than twice the minimum wage of a Spanish worker (see Table 2). When the variable willingness to pay is related to the characteristics of the respondents, it is observed that there are no gender differences, although, if there are by level of studies. The differences are given between the lowest studies level and the rest. Those who have a higher level of education are willing to pay a greater quantity of money (see Fig. 1).

With respect to the second objective of the paper, the main outputs and outcomes have been extracted, based on the answers provided by the respondents. On the one hand, as main outputs (results in the short term that can be measured or assessed directly) would be: *Attraction of investments and specialized services; Plus value added to the current products or services; Reduction of emissions; Decrease of energy costs; Creation of fresh business and job opportunities; Reduction of fossil resource consumption.* On the other hand, the most outstanding outcomes (valuation by the community of the effect produced by the renewable energy introduction in the medium term) would be: *Improvement in services and facilities; Increase in number of visitors; Pollution decrease; Greater business dynamism; Income increase; Promoting imitation effect through energy change.* Fig. 2 contains the positive relationships that have been found between outputs and outcomes. Finally, Fig. 3 contains the main impacts in the long term identified by the respondents.

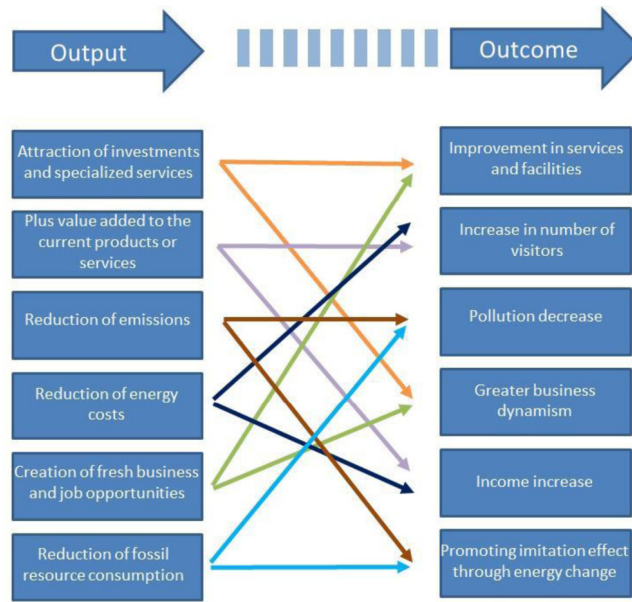


Fig. 2. Relationship between outputs and outcomes.

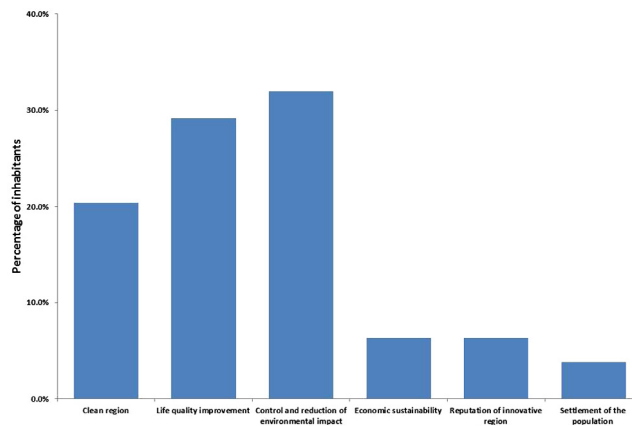


Fig. 3. Main impacts in the long term.

5. Conclusions

The most important outputs, on average, collect aspects related to the three dimensions of sustainability. In particular, the first output is the *Attraction of investments and specialized services*, with a marked social character. In second place, the main economic reason would be the *Reduction of energy costs*. Finally, the *Reduction of emissions* is shown as the most relevant environmental reason to make the transformation to renewables.

Similarly, the three most valued outcomes would be: *Improvement in services and facilities*, *Decrease in pollution* and *Income increase*. Therefore, in the medium term social concerns are maintained as the most valued, but order is reversed in the other two aspects. Thus, the environmental issue has a higher valuation in the medium term than the economic aspects.

When the impacts are analyzed in the long term, it is observed as the environmental aspects are that undoubtedly acquire greater relevance, which is consistent with the growing concern for climate change.

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