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A multi-level approach to analyze the effects of renewable energy in the wine sector

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Abstract

The objective of this paper is to design a map of the positive effects caused by the implementation, in a winery, of a series of prototypes for substituting non-renewable energies for clean energies. For this aim, we propose the use of a multi-level approach including three analyses: a multi-stakeholder analysis to determine all the interest groups affected by this intervention; a multi-dimensional analysis in order to identify the effects from the triple bottom line of sustainability; and a multi-term analysis to classify the effects depending on when they take place: immediate, intermediate and long-term.

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Keywords: Multi-dimensional analysis; multi-stakeholder analysis; multi-term analysis; Renewable energy; wine sector

1. Introduction

The European Union has promoted the use of renewable energy sources by several directives, establishing a common framework for the production and promotion of renewable energy sources in order to limit greenhouse gas emissions. In this sense, the European Union aims to reach a 20% increase in the use of renewable energy by the year 2020 and shifts this task to its member states. Renewable energy sources differ from non-renewable in their environmental and economic impacts. Common features to all renewable energy sources are that they are more

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expensive than the current energy-mix, and none of them is solely beneficial for the environment (Kosenius and Ollikainen, 2013).

Agribusiness is one of the sectors with the highest energy consumption; in fact, its consumption accounted for 26% of the European Union total in 2013 and 28% of this consumption comes directly from the industrial process. This means that 7.3% of all the energy consumed in the EU goes to the production of food and beverages. In addition, Spain is among the five European countries with a larger food and beverage industry (the others are Germany, France, Italy and the United Kingdom). Therefore, Spain is among the countries whose energy consumption is higher. Data in Spain shows how agribusiness has consolidated its position as the country's leading industrial sector, with almost half a million direct jobs, accounting for 21% of the country's manufacturing industry and consolidating itself as the 4th largest economy in the European Union in Production (with a value of € 95 billion). So what is valid for the European Union itself will also be for the Spanish case, in which the introduction of renewable energies would be associated with cost reduction and environmental improvement.

The starting hypothesis is that the agribusiness has a high receptivity for the implementation of renewable energies, since it favours not only the protection of the environment, but also the essence of its business. Within the agribusiness, the wineries and their vineyards, due to their peculiar characteristics, they are more innovative than the rest of the sector and can serve as a model of how the use of renewable energy on a small scale can be profitable.

In this sense, a series of prototypes have been installed in the vineyard of *Viñas del Vero*, which produce renewable energy by photovoltaic generation. The photovoltaic panels are on three different types of support, including a floating set on the surface of an irrigation pond. The system is stand-alone (not connected to the grid) and is managed by an advanced hardware and software system. The energy produced feeds the water treatment plant of the cellar and drip irrigation in the vineyard. The wastewater of the cellar is purified and used for irrigation. The surplus energy produces hydrogen by water electrolysis, which is used on the farm itself, in an agricultural off-road vehicle with a fuel cell.

This intervention is framed within a broader REWIND LIFE project that addresses climate change in the rural environment, both for mitigation and adaptation. As mitigation, it reduces CO_2 emissions related to energy consumption in agricultural activities and industries. As adaptation to climate variations, it allows the production of clean energy for irrigation in remote or isolated locations. Furthermore, noise, spills and other environmental impacts of diesel are avoided, as well as the visual impact of the electricity grid in natural areas. The partners are the University of Zaragoza, CSIC–LIFTEC, *Viñas del Vero* and *Intergia Energía Sostenible*.

The objective of this paper is to determine all positive effects from this REWIND LIFE project by means of a multi-level approach and taking into account all the stakeholder affected by the project (firm, partnership and community), the three dimensions considered on any sustainability problem (social, economic and environmental) and the length of the term in which the effect happens (immediate, intermediate and long-term).

The rest of the paper is organized as follows. Section 2 presents the multi-level approach used in the paper. Section 3 applies the methodology to our case study. Finally, Section 4 includes the most relevant conclusion of the paper and the future lines of research.

2. Methodology

In this section, the methodology used in the paper is presented. It is based on a multi-level approach following the ideas of Qayum et al. (2012). First, a multi-stakeholder analysis is carried out in order to determine all the interest groups affected by this intervention. After that, we perform a multi-dimensional analysis to identify the effects from the triple bottom line of sustainability: economic, social and environmental. And finally, a multi-term analysis in order to classify the effects, depending on the length of the term in which they take place: immediate, intermediate and long-term. Fig. 1 shows a Rubik cube in which each small cube represents the results of the project for the combination of the three levels: dimension, stakeholder and length of the term.

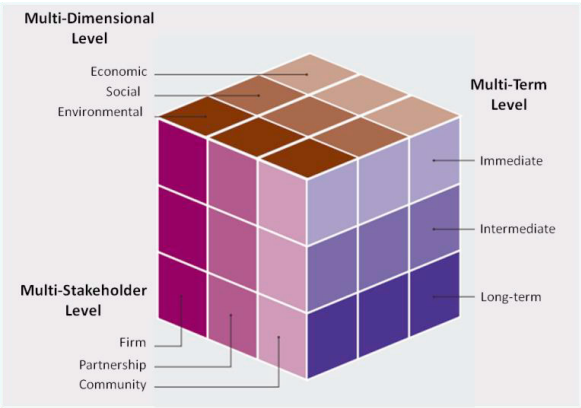

Fig. 1. Tridimensional scheme for the effects of an issue by dimension, stakeholder and length of the term, based on Qayum et al. (2012) [5]

2.1. Multi-stakeholder analysis

The Stakeholder Theory conceives the company as a nexus of actors whose interests and benefits are mutual (Freeman, 1984). This theory justifies that the company must not only satisfy the interests of the shareholders but also of all groups that can affect or be affected by the actions of the company, and without which the company could not exist. Many authors, such as Freeman (1984) and Campbell (1997), have defined and classified interest groups in organizations. One of these definitions classifies the stakeholders from a restrictive approach (those groups without which the company would not survive) to a broad approach (any person, group or entity that has a direct or indirect link or interest, with or about the organization). In this paper we choose this last approximation.

The replicability of the project, as the main indicator of its success, will depend not only on the perception of the companies that promote it, but also on the other stakeholders who have interests in the project. Hence, it is necessary to analyse the project also from the stakeholder theory, since it allows managing the project from a Total Quality Management perspective.

2.2. Multi-dimensional analysis

The increasing relationship between business and society has changed the way business is conducted, now being characterized by taking into account the effects that all their activities generate on their clients, employees, shareholders, local communities, environment, and society in general. In this new context, companies need to incorporate new variables into their core business to respond to the new concerns and expectations of stakeholders. It consists on considering, when making decisions, not only the financial aspects associated with the activity but also the non-financial ones, i.e. the environmental concerns and the investment decisions conditioned by social criteria. This implies the adoption of a new business management model based on the creation of sustainable and balanced value for all stakeholders.

This approach implies: a sustainable economic system capable of producing socially demanded goods and services; a socially sustainable system that allows the achievement of distributive equity or adequate provision of social services, such as health and education, among others; and an environmentally sustainable system that avoids the overexploitation of non-renewable resources. In this sense, environmental commitment is a good corporate health indicator, since it is not possible to have long-term sustainability in an increasingly degraded environment. The environmental awareness of consumers and companies is still insufficient. This fact has motivated the governments to act and guarantee the fulfilment of the environmental norm (García del Junco et al., 2014).

2.3. Multi-term level

The effects caused by the activity of the company are manifested both in the short, in the medium and in the long term. Hence, a number of authors and institutions make a distinction between immediate, intermediate, and ultimate

effects (Van Tulder et al., 2016). There is growing consensus, in which the immediate effects refer to the participating organizations, while the intermediate effects, just like the long-term ones, affect the targeted communities. Van Tulder et al. (2016) name the long-term impacts as ‘‘sustainability’’. Impacts are the ultimate changes that happen beyond the partnership. However, Wainwright (2002) said that impacts include both intended and unintended effects, negative and positive effects and long-term and short-term effects. Liket and Maas (2012) showed that long-term effects are difficult to measure, so they seem to have less impact than they actually have, in spite of the considerable achievements that would have been got.

3. Case study

The case study seeks to identify the socioeconomic and environmental impacts that have the implementation of a series of prototypes in order to carry out the substitution of non-renewable energies by clean energies in the wine sector. Concretely, it consists on demonstrating if the use of renewable isolate energy system prototypes for agricultural (vine), manufactures (winery) and vehicles and agricultural machinery (field) in the wine industry (demonstrative example) is profitable from an economic, social and environmental point of view. The substitution of fossil energies for renewable energies has been carried out in three directions:

- In the field, the substitution of diesel by renewable hybrid will drastically reduce the consumption of diesel in irrigation and the corresponding emissions.
- In the fleet of vehicles and agricultural machinery, the substitution of part of the consumption of gas oil by the use of hydrogen of renewable origin will avoid polluting emissions.
- In the cellar, the substitution of electric consumptions, for example, for the purification of water, by the renewable generation will avoid the power consumption of the electricity network and the associated emissions.

3.1. Multi-stakeholder level

The European Union demands within the framework of the LIFE projects to know the socio-economic impact that the project has in the area in which it is carried out. Because of this, it is necessary to determine the actors who may be relevant for the project. The methodology applied for its identification consisted in bringing together a group of informants (companies participating in the project and members belonging to the region in which it is developed), with different profiles and experiences, in order to determine the main groups of interest in the project.

This multi-stakeholder analysis aims to detect the interest groups for which the substitution of fossil fuels for renewable energies has a positive effect. The identified stakeholders can be classified into three levels: firm, project partnership and community. In turn, the community is divided into three major groups: individuals, companies and institutions. Table 1 shows further details of each of these groups’ composition.

Table 1. Classification of the stakeholders

Typology		Stakeholder	Column B (*t*)
Firms			Unizar, CSIC-LIFTEC, Intergia, Viñas del Vero
Partnership			Life Rewind Project
Community			
			Inhabitants of the region
	Individuals		Visitors
			Company workers
			Consumers of the company products
		Clients	Wine cellars in the area
	Companies		Other companies / sectors likely to install renewable energy
		Suppliers	Service companies: accommodations, trade, catering...
			Materials and supplies companies for renewable energy system
		Public	County council, county, city councils
	Institutions	Private	Business and consumers associations
		Scientific Community	Training centers
			Research centers

*Carbon dioxide (CO_2), carbon monoxide (CO), sulfur oxides (SOx), oxides of nitrogen (NOx), volatile hydrocarbons (HC) and solid particles (C+) emissions.

The first level is made up of firms which are the participants in the project. The second level is the partnership which consists of four companies of different sizes. Zaragoza University is the largest company and the rest of the companies are SMEs. Half of these firms are private and the others are public. Finally, the third level is the community which is divided into three major groups: individuals, companies and institutions.

3.2. Multi-dimensional level

The effects caused by the activity of the project are manifested both in the economic, the social and the environmental dimensions. Thus, for example, some economic effects that could be achieved with the project may be: compliance, innovation, profitability improvement of the project companies, new employment and tourism niches, territory sustainability, reduction of energy bills, increase of the number of visitors to the winery, ability to access new markets, socially responsible investment, etc.

As positive effects in the social dimension could be considered: job creation, community involvement, health, consumer safety, marketing and labeling of product and service, personnel trained in renewable energies, increase of the number of appearances in press, radio, television; conferences and congresses..., accumulation of scientific findings, settlement of the population, new employment and tourism niches, image improvement of the project.

Finally, among the positive environmental effects would be aspects such as: eco-efficiency, reduction of CO_2 emissions, recycling, reduction of energy consumption, reduction of resources' consumption, conservation of the environment, etc.

3.3. Multi-term level

In our case study, we consider that there are short, medium and long term effects. The short-term effects occur mainly at the level of each of the companies participating in the association, although there are short, medium and long-term effects for each of the identified stakeholders, as Wainwright (2002) considered. According to Liket and Maas (2012) long-term effects are the most difficult to measure.

Among the immediate effects would be: reduction of emissions, renewable assets in its facilities, reduction of energy bills, increase of the number of visitors to the winery, personnel trained in renewable energies, increase of the number of appearances in press, radio, television, conferences and congresses...

As intermediate effects, we could consider the following: profitability improvement of the project companies, new employment and tourism niches, image improvement of the project firms, increased research in project areas, major training in renewable energies, conscious customers with the use of more environmentally respectful products, endowment of energy-efficient. Finally, the use of renewable energies within its energy mix makes customers aware of the use of environmentally respectful products.

To conclude, some of the long-term effects are: economic dynamisation of the region, sustainability of the territory, accumulation of scientific findings, and settlement of the population, reputation of clean region or control and reduction of environmental impact.

4. Conclusions

This paper has permitted us to design a map of the positive effects caused by a winery's implementation of a series of prototypes in order to carry out the substitution of non-renewable energies by clean energies through a LIFE project whose partners are the University of Zaragoza; CSIC – LIFTEC; *Viñas del Vero* and *Intergia Energía Sostenible*. In order to carry out this aim, we have proposed the use of a multi-level approach including three analyses. First of all, we have carried out a multi-stakeholder analysis to determine all the interest groups affected by this intervention. After that, we have performed a multi-dimensional analysis in order to identify the effects from the triple bottom line of sustainability: economic, social and environmental. And finally, we have carried out a multi-term analysis, to classify the effects depending of the length of the term in which they take place: immediate, intermediate and long-term.

The result of these three analyses allows us to address the problem in a three-dimensional form, whose way of visualizing it would be through a Rubik Cube, where each small cube would represent the intersection of the three levels: dimension, stakeholder and length of the term.

In our future research agenda we contemplate, on the one hand, the possibility to determine all the effects derived from the project and to categorize them in their three levels; in other words, the determination of all the effects included into each of the small cubes of the Rubik Cube. On the other hand, another objective is to know the perception about the effectiveness that external groups grant to the implementation of the project in the medium and long term. Due to the difficulty of knowing the medium and long term effects in a direct way, we will use surveys in order to know the Stakeholders' opinions on these socio-economic and environmental aspects. The questionnaires will allow the characterization of the stakeholders in terms of their socio-demographic and organizational typologies, their perception of environmental issues, the motivation for introducing the renewable energies and the degree of implication with environmentally respectful measures (recycling, consumption and energy saving...).

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