

Contribution of renewable energy to regional structuring in southern Europe

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Abstract:

Renewable energy is considered a key factor within territorial cohesion strategies in Europe. Among the main reasons, the use of renewable energy makes it possible to supply energy to locations with limited access to the distribution networks or to partially substitute the energy consumed and subsequently reduce the cost, favour access to new services and new economic activities and, strengthen others that already exist. Moreover, the renewable energy sector identifies synergies with traditional economic activity such as the possible energy valorisation of certain industrial and agricultural waste, or the implementation of energy crops. In short, renewables enable the surge of the necessary conditions for local development, actively contributing to regional structuring and economic decentralization, which are desirable goals in the countries of the European Union. Although it is not a recent phenomenon, the tendency towards depopulation in rural areas of Southern Europe is currently a matter of paramount importance. The promotion of employment-generating activities in rural areas is undertaken in many modern societies as a way to counteract migration from the countryside to towns. In this particular case, the renewable energy sector is also proposed as one of the most promising sectors. This paper aims to contextualise the socioeconomic impact of the use of renewable energy in a regional scope and measure it using a set of indicators selected on the basis of the main objectives of the Sustainable Rural Development Programs in Southern Europe. The paper proposes a methodology to verify the role of renewable energy sources as a factor for intraregional structuring which is applied to the case of Aragon (Spain). Analysed information arises from a survey campaign and additional desk research on a sample of 250 companies that is furthermore contrasted with the points of view of 30 key players in the economy of the region. The qualitative and quantitative analysis of this case study concludes that renewables have a great potential to reinforce economic activity and social well-being in Aragon, due to the generation of high quality employment (good qualitative levels for job stability and specialization and reasonably good indicators wage-wise are shown) and supplementary incomes, aspects that may be an incentive for stabilizing the population in rural environments and lessening the imbalance between these areas and urban centres.

Keywords:

Renewable energy, regional development, socioeconomic impact, employment

1. Introduction

Employment appears as a key point in all of the regional structuring policies where the establishment of new sectors of activity and the lifting effect on existing sectors are the basis on which the population is stabilised and reinforced [1].

These plans for cohesion can be also applied within a territory, especially if physical remoteness and sparseness of population distribution exist. Such is the case with most rural areas in Southern Europe.

The implementation of strategies integrating sustainable development with new ways of enhancing natural and cultural assets, strengthening the economic environment in order to contribute to job creation and improving the organisational capacity of their community, is an opportunity to improve the balance between the urban and the rural scene.

Although it is not a recent phenomenon, the tendency towards depopulation in the rural areas of Aragon (Spain) is currently a matter of paramount importance. The general drop in the birth rate that is affecting the country and the region has become more marked over the years due to continuous migration processes from rural to urban areas. The reduction in the rural population accentuates the problem of insufficient infrastructure and access to services and at the same time fuels the generational imbalance, with few young people and children to maintain and develop local economic models.

The promotion of employment-generating activities in rural areas is undertaken in many modern societies as a way to counteract migration from the countryside to towns while identifying the green sectors that most contribute to employment in rural Aragon was the main objective of a study promoted by the Economic and Social Council of Aragon (CESA).

The information provided by more than thirty experts from very diverse socioeconomic fields in Aragón, in close contact with the territory situation, is in line with the positive thesis defended in prior studies such as the OECD report titled *Linking Renewable Energy to Rural Development* [2].

In particular, the renewable energy sector is proposed as one of the most promising sectors. The renewable energy sector is defined as the sector of activity which comprises both producers and suppliers of services, solutions and technologies which are generated around the exploitation of renewable energy sources (wind energy, solar radiation, biomass and hydropower).

While recognising its contribution to the dimension of environmental sustainability, among the main reasons it is important to indicate that, as renewable resources are accessible throughout the region, the use of renewable energy makes it possible to supply energy to locations with limited access to the distribution networks or to partially substitute the energy consumed and subsequently reduce the cost, situations that favour access to new services, new economic activities and the strengthening of others that already exist.

Moreover, the so-called renewable energy sector identifies potential synergies with traditional economic activity in rural areas such as the energy valorisation of certain industrial or agricultural waste, or the implementation of energy crops that could open up a new line of activity in the agricultural sector, contributing to its diversification [3]. Similarly, renewable energy installations could generate additional incomes which can be reinvested in local development.

In short, renewables enable the surge of the conditions necessary to generate development and employment in rural settings, contributing to regional structuring and economic decentralisation, which are desirable goals for the countries of the European Union.

Nevertheless, the confirmation of this potential requires another new, most specific, analysis of the vectors that effectively promote the regional structuring of the rural areas, and the role that, in this regard, the development of the renewable energy sector would have.

A key output from this study will be the analysis of the quality of jobs that are preserved and created. In fact, the value of employment for society varies with the evolution of the labour markets themselves, and in scenarios with low levels of employment there is the risk of favouring any type of employment, even if it is of low quality. For example, indiscriminately promoting activities needing high levels of unskilled labour may harm economic development in the long term as employment with a greater added value is neglected. Renewable energy, like any other initiative benefitting sustainability must improve social well-being within a framework of inter- and intra-generation solidarity, an aspect that must be taken into account in any promotion policy.

The aim of this paper is to contextualise the socioeconomic impact of renewables in a regional scope and to measure it through a set of indicators. This study will serve the purpose of demonstrating its contribution to regional structuring through the development of rural areas.

2. Regional structuring and rural development: Aragon as a case study

In the past, regional structuring tended to be considered from the viewpoint of compensating of the inter and intra-regional imbalance, both between the countries that make up the European Union (EU), through Community policy, and in each of them within the framework of the regional development policies.

Nevertheless, the current concern of the Member States is focused on the existing imbalances within their own territories and, in particular, within each of the regions that comprise them. The progressive depopulation of rural areas in favour of large urban centres is one of the most important factors behind the adoption of specific national policies, complementing those of the EU which - in cases with very low population density as in Aragon - are insufficient.

Aragon is located in the north east of Spain, with a surface area of 47 719 km², which accounts for 9.4% of the Spanish territory. This area is distributed as follows: province of Huesca 15 636 Km², province of Teruel 14 809 Km² and province of Zaragoza 17 274 Km².

The Autonomous Community of Aragon has a population of 1 347 095, which represents 2.86% of Spain's inhabitants. It should be emphasized that more than half of Aragon's population, 50.8%, live in the capital city of Zaragoza and its metropolitan area (675 000 residents), while the rest of the Aragonese territory is very sparsely populated: 28.29 inhabitants/Km² which is the lowest population density figure in Europe (European average is about 70).

Some 97% of the land and 42% of the population is considered rural. Baseline data from the RDP indicates that Aragon's rural areas attract 40% of regional employment and generate 38% of the region's total Gross Value Added (GVA).

Main socioeconomic strengths include low unemployment rates (much below the national average), highly qualified human resources, high productivity in irrigation areas, gradually increasing size of agricultural holdings, competitive and high quality livestock sectors, agri-food sector with real potential for growth, progressive integration of the environment into agricultural activities, and growing diversification of the rural economy (e.g. tourism, hunting, crafts, renewable energies). One of the main weaknesses is the acute rural-urban duality and concentration of the population and economic activity in the region's capital, Zaragoza, which is translated into a significant internal demographic and economic imbalance. Population ageing further contributes to the depopulation of rural areas. Other weaknesses noted in the RDP documents include low activity rates, excessive dispersal of small businesses (99.2% SMEs with 0-50 employees), deficiencies in rural infrastructures and insufficient development of IT in rural areas, climate conditions that do not allow versatility of dry land crops (arid climate and water deficits), limited diversification of agricultural production, small economic dimension of farms, high differences between irrigation and dry land surfaces (low profitability of dry land crops), scarce generation of value added in the agri-food industry (productivities lower than the national average of the sector). In terms of the environment, the region has a large variety and richness of landscapes, protected spaces and species, Natura 2000 areas, extensive dry land systems of high natural value and a positive evolution in the quality of surface waters. It is one of the top wind energy producers of Spain and has a high potential for production of biomass. However, one of the most important environmental problems is the soil deterioration process caused by the erosion and desertification. Other environmental weaknesses include water pollution by nitrates (especially in vulnerable areas, half of which correspond to the region's irrigated crops) and significant agricultural surface located in Less Favoured Areas.

In Spain, the instrument for implementing the policy aimed at correcting the imbalance between the rural areas and cities within the same autonomous community is currently the Law 45/2007, of 13 December. Through sustainable development of the countryside it pursues to improve the

socioeconomic situation of the rural population as well as to grant the access to sufficient, good quality public services. In particular, the law, as set out in its preamble, grants preferential treatment to women and young people, on whom the future of the countryside largely depends, and promotes the development of all of the regions own resources.

It is, in fact, a law with a clear territorial approach which criteria and guidelines of town and country planning have been used in this study as definitions for countryside and sustainable rural development.

The definition of regional structuring used in this study was also obtained from Law 45/2007, and can be summarised as follows:

“The structuring of a region is measured according to its infrastructures, facilities and basic services from public transport and connections between the population nuclei of the countryside and with the urban areas, ensuring the energy supply, waste treatment and the provision of municipal public services. Similarly, it involves the availability of information technologies and communication to favour the economic activity, safety for residents and access to good quality basic public services for the rural population. These services include education and culture, through specific attention to a wide variety of aspects regarding the pupils and the centres, but also regarding proper maintenance of facilities and a good range of cultural alternatives. In addition, the health measures require the public health system to adapt to the needs of the countryside, completing the health infrastructure, maintaining and improving the facilities, and guaranteeing access to high quality specialised health care in all types of rural areas”.

In the other hand, countryside is defined as “the geographic space formed by the aggregation of municipalities or minor local entities with populations under 30,000 inhabitants and a density below 100 inhabitants per km²”.

Considering the previous definition and the fact that Aragon has a population density of 28.2 inhabitants per km² (Aragonese Institute of Statistics 2011), more than 95% of the region of Aragon is included in the range of application of the law, and approximately 42% of the Aragonese population lives in the countryside, where its population density is 3 times below the national average.

The effective application of Law 45/2007 was therefore crucial for the Autonomous Community of Aragon, which through Decree 84/2010, of 11 May, established the organisational framework for the application of the law in Aragon and that was the basis for signing the protocol of collaboration with the national government on 21 December 2010 to apply the Programme for Sustainable Rural Development in Aragon.

Complementing the policies, in Aragon there are organisations like the Office of Socioeconomic Development and the Board of Town and Country Planning, and strategies such as the Territorial Distribution Strategy for Aragon which is a territorial planning instrument covered by Law 4/2009, of 22 June, on the town and country planning of Aragon (LOTA). In addition to providing guidelines for planning the regional development of Aragon, they are some of the instruments with which the autonomous community counts to carry out the objectives targeted for sustainable rural development.

In synthesis, the main objectives of the Sustainable Rural Development Programme in Aragon are to maintain the rural population and to improve the quality of life and income levels in rural areas by working on the following strategic lines of action:

- Environment
- Infrastructures and basic facilities
- Economic activity and employment
- Services and social well-being

As a consequence of its effect on the four lines of action above, the development of renewable energy is one of the main areas of work.

Regarding the environment, it enables a response to an incipient demand and guarantees the energy supply with minimum effect on water, the ground and the atmosphere, an aspect that is broadly agreed. Moreover, implementing the use of renewable energy often entails the regulation of a series of infrastructures such as roads, telecommunications services, etc., from which other activities or the population itself can benefit.

The following sections present the results of a qualitative and quantitative analysis of some of the socioeconomic indicators of territorial cohesion for the case of Aragon which confirms the potential of the renewable energy sector to reinforce economic activity, employment and social well-being in the countryside.

3. Methodological framework

As previously mentioned, this paper arises from a study promoted by the Economic and Social Council of Aragon (CESA). One of the specific objectives of this study was to obtain some indicators for ranking local green sectors concerning its capacity to generate employment actively contributing to regional structuring and economic decentralization.

The above study was focused on the following activity sectors previously defined as green by the OECD and Eurostat (1999):

1. Waste water treatment
2. Solid waste management and treatment
3. Renewable energy production
4. Management of protected natural areas
5. Management of forest areas
6. Environmental services
7. Environmental awareness and information
8. Organic farming
9. Rural tourism

The field work was one of the main actions of this study: the search for information was performed by means of a survey aimed at company managers, designed with the objective of facilitating the segmentation of the socio-economic results such as the turnover of the companies, the size, composition and training of the workforce, the technology used, their main activity, the sub-sector in which they operate, the specialized staff training needs, etc.

The survey was structured in several modules as it breaks down in the following table.

Table 1. Questions used for the study of green jobs in Aragon of the complete survey (authors' compilation)

Module	Objet	Used questions for the present analysis
Module G) Main	Green sector companies	all
Headline	Identification data of the company	all
Module A)	Eco-innovation in processes	none
Module B)	Company organizational structure	none
Module C)	Energy and material resources management at the company	none
Module D)	Standardization and environmental accounting at the company	none
Module E)	Energy consumption	none

However, the data of interest to the present study are concentrated in the module G aimed to identify:

- G1: Green subsector to which company belongs
- G2: Level of the value chain in which the company is
- G3: The gender profile of employees
- G4: Number of employees, employment trends within a framework of 3 years and training needs regarding different functional levels (management, production, sales, administration, design, consultancy, installation and maintenance).

Gathering the primary information through questionnaires required the creation of a database of companies. Many “green sectors” as it is the case of renewable energy are not represented as such in the classifications and sources of economic statistics, so the population to study was defined ad hoc. As a result of this task, it was verified that 493 companies whose main activity was directly linked to one of the considered green sectors were registered in Aragon.

The questionnaire was prepared by a multidisciplinary team of researchers responsible for the study and several experts in statistics and data processing, environmental management of the company, renewable energy, energy efficiency, resource management and management and treatment of waste. The process lasted for two months and was carried out in several phases in order to analyze questions from different points of view and anticipate potential problems appearing in the process of obtaining information.

The survey was made available to the companies as a questionnaire accessible on the internet. It was stored on a server and linked to a database where the responses received were automatically saved. A total of 132 valid surveys were received.

Table 2. Collection of data and information phase description

Universe	Companies located in Aragon with activity in the green sector previously defined
Population	493 companies
Survey typology	On-line
Sample size	132 companies
Analyzed variables	Sub-sector of activity to which the enterprise belongs Activity phase where the company operates Employees per functional profile Percentage of men and women in the workforce Employment evolution and trends Training needs
Dates for the field work	From April to August 2013
Data collection platform	Databases designed for that purpose in Microsoft Excel 2007

Regarding the sector categorized as renewable energy production, 248 companies were part of the targeted population and 48 valid surveys were identified.

However, the most significant part of this study was the application of qualitative methodologies. These provided first-hand knowledge of new experiences and production and business activities in the area of the environment, from the first-hand and explicit views of participants directly and indirectly involved in this sector. They offered appropriate criteria for the study of its feasibility in the Aragonese territory, especially the latter, to give it a more participatory and motivational dimension, obtaining valuable information from those who are directly involved in the considered context.

The methodological tool for approaching everyone involved in the chain of economic value in the green sector was the semi-structured interview.

The participant’s profile was as follows:

- Representatives of the public agencies in the field of the environment, industry, innovation, etc.
- Public bodies of inspection and control in environmental matters
- Regional experts in the field of sustainable rural development or renewable energies
- Associations and environmental consultants
- Representatives of trade unions, cooperatives and/or business organizations related to environmental issues
- Professionals of large private companies

By means of semi-structured interviews, the attitude, expectations and willingness of those directly involved in the implementation of these new emerging productive activities were disclosed.

The secondary sources were obtained using the results achieved in the subject by the research team, from the bibliographic study, sector reports, the scientific and technical literature, the SABI database, Websites, etc. The exhaustive bibliographic review made it possible, at the same time, to reformulate the vectors to analyse in view of the specific objectives of the study and establish the variables to be compiled.

4. The development of the renewables in Aragon

The interviewed experts agreed that the renewable energy sector is the most promising for regional structuring and economic decentralization.

This section includes the detailed analysis of the research results drawing up a full map of the industrial sector and employment of the installations and companies directly related to renewable energy in the region and the professionals employed.

4.1. Renewable energy resources

Regarding energy sources, Aragon has a remarkable wind power potential. According to the data of the Spanish Wind Energy Association at the end of 2013 there were 1,893 MW installed, which constituted 8.24% of the total wind power installed in Spain [4].

Hydropower use is high (49% of total potential) and there are 56 small hydropower plants with an installed capacity of 254 MW [5].

The thermal solar power installed in Aragon in 2013 had a ratio of 25.6 kWth per thousand inhabitants, substantially below the Spanish average (51.4 kWth/1000 inhabitants) and the European average (58.9 kWth/1000 inhabitants), with a high potential for development of this sector in the region. The photovoltaic power installed in 2007 amounted to 166 135 kWp, of which 169,666 kWp corresponded to installations connected to the grid and the remaining 3,531 kWp to isolated installations [6].

The consumption of solid biomass in 2013 was 12.94 ktoe (the ninth position in the national ranking) while the installed electrical power out of biomass was 25.4 MW.

Table 3 shows the main ratios of the energy structure showing how Aragon is above the Spanish average for establishing renewable energy sources and on track to meet the objectives set by the European Union for the year 2020¹

¹ The European Union, in its Communication of 23 January 2008 from the Commission to the European Parliament, the Board, the European Economic and Social Committee and the Committee of the COM Regions (2008) 30 final “20 20 for 2020: Europe's Climate Change Opportunity”, proposes as one of its objectives to triple the share of renewable energy in primary energy consumption, from the current 7% to 20% in 2020.

Table 3. Comparison of the energy structure of Aragon, Spain and the European Union (data for 2013)

	Aragon [6]	Spain [7]	European Union [8]
Primary energy consumption produced with renewables	25.2%	14.2%	7.5%
Electricity production using renewables	32.5%	14.3%	25.8%
Degree of self-supply	35.79%	27.9%	--
Export of electricity generated	39.91%	1%	--
Percentage of electricity consumed that is of renewable origin	105.7%	39%	25.8%

Although energy has always been a basic strategic factor in the development of the autonomous community of Aragon, the abundance of renewable energy resources, the institutional support and the creation of its own technological and business network have been determining factors in the development of renewables in the Region [9].

The immediate future in Aragon will continue to offer a leading role to the renewable energy sector as it does not emit greenhouse gases and improves the reliability of supply. In addition, an economic context such as today's, makes it even more important to promote other ways of organisation that are in tune with growth and employment, without forgetting the effort to protect the environment. Renewable energy will see its position reinforced as the most suitable source for small and medium-sized enterprises [10].

4.2. The renewable energy sector

The Autonomous Community of Aragon presents characteristics that make it suitable for the development of a green economy throughout its territory. On one hand, its geostrategic location, its peculiar energy structure with abundant endogenous renewable resources, its diversified industry with extensive experience in the chemical, energy and automobile sectors, and the existence of consolidated research institutes and groups, mean that Aragon has a high potential to become a leader in the implementation and development of a sustainable economy.

As a result of the availability of excellent resources (human, physical and natural capital) and the energy policy developed by the regional authorities in Aragon, the renewable energy sector was, without doubt, the green economy activity that has experienced the most marked growth in terms of number of companies [11], although this has slowed down in recent years.

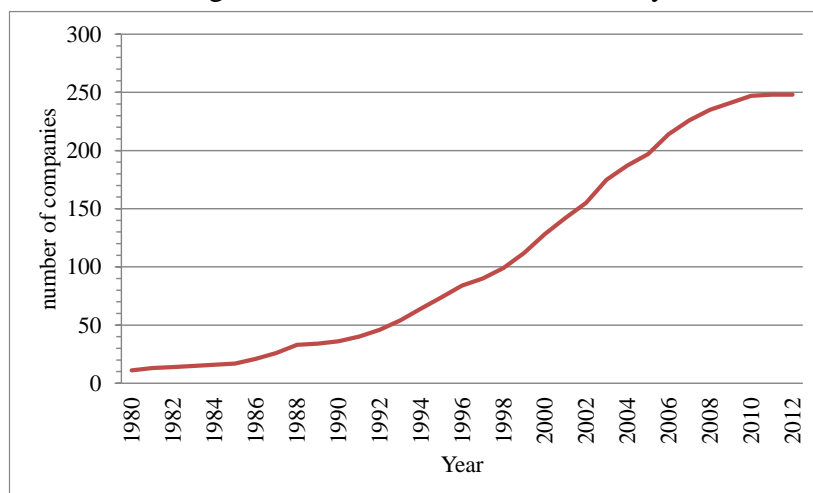


Fig. 1. Evolution of the number of renewable energy companies.

According to CIRCE directory of renewable energy, in mid-2013 the sector comprised 250 companies. Figure 1 shows the evolution of the number of companies from the 1980s to 2011.

The general situation about the renewable sector in Aragon can be identified from the information coming from the SABI company database.

In terms of number of employees, almost of the companies are SMEs, although they are somewhat larger than the average in the Aragonese economy where 88.61% have less than 10 employees compared to 68% in the area of the renewable energy sources. In the other side, barely 5% have more than 250 employees.

A rural setting is linked to 31% of the companies (45% in the remaining economy), although there are differences between provinces. From the companies in Huesca, 76.45% are located outside its capital and 62% of those from Teruel are found in the countryside. The trend is reversed for the province of Zaragoza, which is the region's economic pole, and where 70% of the companies are located in urban environments.

Through the economic data available for the whole of the population (2011) it is possible to estimate the volume of business generated by the companies that comprise the renewable energy sector in Aragon and that reached 514 million euros in 2011, which is 1.46% of the GDP, a contribution that has remained barely unchanged along the last years (see Table 4).

Table 4. Evolution of the percentage that the revenue of the Aragonese companies represents of the Aragon's GDP (authors' compilation)

Year	2005	2006	2007	2008	2009	2010	2011
%GVA/GDP	3.04%	3.82%	3.66%	3.73%	3.86%	3.44%	3.52%

In addition, the productivity in the renewable energy companies analysed, calculated as GVA per employee, comes to 52,578 euros per person per year, which is 7% higher than the average productivity of the Aragonese economy. The broad margin existing between the average productivity and the expenditure of the employees is significant: 22,510 euros/year.

5. The potential of renewables as a driver for regional structuring through employment generation

5.1. The amount of generated jobs

Using the information provided by the companies through the questionnaire (question G4) and extrapolating to the whole population, 9500 direct jobs were estimated.

From these, 60% are in the countryside (compared to 40% for the Aragonese economy as a whole). This serves as evidence that the employment generated in green companies can be considered a factor of interest for the structuring of the region.

It was possible to observe in Table 5 how the companies, especially those created before 2005, experienced a reduction in the total number of employees, partly due to the degree of maturity of the technology and in particular to the stages of the value chain in which the companies of these subsectors carry out their main activity.

Table5. Evolution of the total number of employees in the period 2005-2011 in Aragon's green companies (authors' compilation)

Year	2005	2006	2007	2008	2009	2010	2011
Number of employees	8008	9264	10680	10919	10885	9618	9448

In this point the study had to respond to the following question: Does renewable energy promote a significant employment creation in Aragon?

There are numerous studies that relate the production of renewable energy with the generation of employment although few speak of the net generation of employment as they do not also account for the possible job losses from conventional sectors. The authors estimated that in Aragon, renewable energy generates between 1.8 and 4 times more employment per MW installed than technology based on fossil fuels, therefore the net balance would in this case be positive.

In general terms, to assess the effect of the exploitation of renewable energy sources on employment, the methods used can be classified in two categories: a) those based on “input-output” (I-O) economic models that examine the economic relationships at domestic level [12-14] and b) those that use analytical methods [15-17].

The results obtained through both procedures lead to estimate coefficients or ratios that quantify the jobs created per unit of installed power or electricity generated using the energy sources considered. There are numerous references in which some of these ratios are compiled [16, 18, 19].

The information that this type of ratio provides is the amount of employment that is generated for each specific unit installed and its most immediate use is to provide a prediction of the employment that would be generated, provided the increase in the activity was known previously (in the same terms as the corresponding specific unit) or the planned investment (estimating the new specific units). In the case of installations for the production of electric power of renewable origin, this unit is the Megawatt (MW) installed.

Nevertheless, as one can deduce from the dispersion in the values displayed (Table 6), the use of these ratios presents some limitations.

Table 6. Ratios of employment for different electricity generation technology [21]

Jobs/MW	Manufacture, construction and installation	O&M/fuel processing
Solar photovoltaic	5.76-6.21	1.20-4.80
Wind	0.43-2.54	0.27
Biomass	0.4	0.38-2.44
Coal-fired power plant	0.27	0.74
Gas-fired power plant	0.25	0.70

Firstly, the employment ratios are not constant in time and, in fact, several authors incorporate correction factors to reflect the experience curves. Some of the studies analysed on the generation of employment in the renewable energy sector assume that the employment ratios can be reduced as a result of the economy of scale and the growing experience of the renewable energy industry. The study carried out by Heavner and Churchill [21] assumes an annual decrease of 10% in the ratio for construction and 5% in that for operation and maintenance, while the reduction in other studies does not follow a fixed model, like for example the study by Kammen et al. [19].

This aspect appears after analysing the data compiled in the undertaken study. Jobs from companies whose activity was related with renewable electricity generation were extracted and related to the installed MW in Aragon in the 2004-2012 period. As can be observed in Figure 2 the ratio of direct employment per MW in Aragon reached its maximum in 2008, after which it decreased, despite the increase in the installed power.

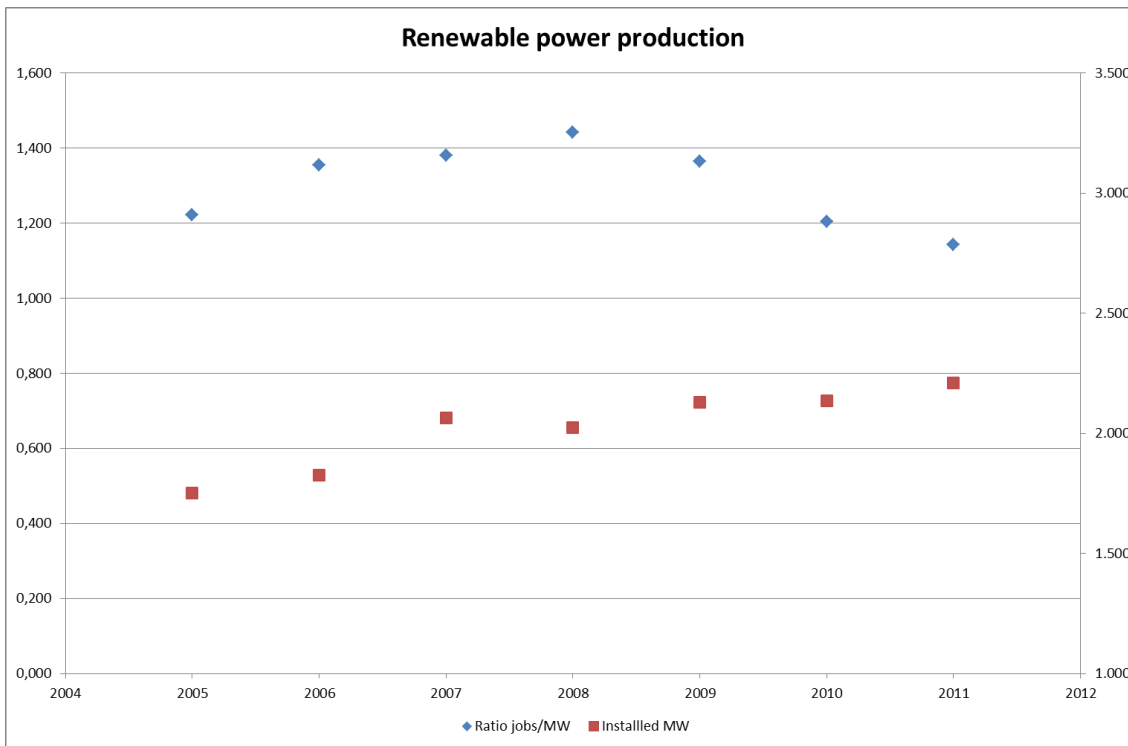


Fig. 2. Evolution of the employment ratio and renewable electrical power sources in Aragon. Period 2005-2011 (authors' compilation)

The data for the last three years enables us to discern certain exponential trend in the evolution of the ratio and a possible stabilisation around a value of 1.1 jobs/MW installed. As shown in Figure 3, the renewable energy sector can today be considered a mature subsector in Aragon, with stable employment rates. This does not mean that it cannot continue to grow or improve in terms of productivity or competitiveness, but that it is highly likely that it will not be so sudden.

Llera et al. [22] showed that the potential for local job creation for a certain renewable technology depends not only on the size of the installation (through the unit of installed MW) but also on the level of development and the structure of the industry in the region. It is clear that there is a significant relationship between the stage of the activity in which the employment is created and the duration of this stage. For example, differences were observed during the installation and start up stages, where the duration of the work is relatively short, and the stage of operation and maintenance (or fuel processing) in which the duration of the employment depends on the useful life of the corresponding installation. In this regard, Llera et al. [23] demonstrated that these differences regarding the intensity of work throughout the value chain of the sector, in conjunction with its structural characteristics in a certain region, can explain different trends in the generation of employment.

Due to all of this, the key characteristics of the employment can be defined according to the stage of the value chain in which it originates, as summarised in Figure 3.



Fig. 3. Characteristics of the employment according to the stages of activity of the sector in which it originates. (Authors' compilation)

In Figure 4 it is important to note how the employment that is more likely to remain in the region is related to the stages of operation and maintenance, and it is not very labour intensive, so it can be expected that renewable energy will not generate large volumes of employment in rural areas.

Moreover, in the event of any initiative aimed at promoting renewable energy as a factor in regional structuring through the generation of employment it is necessary to further analyse the impact that the different stages have on employment, to provide key lines of action that boost the generation of employment in any determined stage that is of interest, whether through promoting innovation (that increases the impact on the local economy of the employment in the first stage) or the professional training (that favours the establishment in the region of manufacturing plants of components and technology or reduces the need to use foreign installers).

5.2. The quality of the employment

Today, any strategy and intervention by the public administration willing to promote the generation of employment linked to its benefits in environmental terms, as is the case of green employment, must take into account, in addition to the total number of employees resulting from the incentives or grants, the stage of the value chain in which the employment is generated, the degree of technological maturity of the subsector to which the grants are directed and other factors, that could be defined as “qualitative”, which guarantee that the new employment promoted by the plan offers the desired solution in the medium and long term to the problems of the labour market. In the specific situation of Aragon, that it helps to alleviate the territorial imbalance of the autonomous community.

Some studies on the subject point out how the employment generated in green economy sectors and in particular those of renewable energy meet certain characteristics due to which they can be considered “quality employment” such as the statement of the UNEP (2008) which includes social aspects in the term “green”, as it considers that the employment has to respond to minimum conditions of dignity (“decent”) [24].

For quality in employment, in its application to the green subsectors in Aragon, the approach in the communication of the European Commission to the Board, the European Parliament, the Economic and Social Committee and the Committee of the Regions entitled “*Social and employment policies - A framework for investing in quality*” (COM(2001) 313 final, 20 June 2001), was considered, a document extremely useful for understanding the model of quality in employment used by the European Commission and that provides specific elements with which to evaluate the situation in the different member States and to draw up public employment policies.

The general idea of quality in employment is linked to aspects of labour relations considered most favourable for staff and their social insertion such as:

- Stability as opposed to precariousness
- High salaries as opposed to low wages
- Expectations of promotion as opposed to final posts
- Broad content as opposed to narrowly limited jobs
- Safe work as opposed to risks at work

With the objective of establishing a framework for analysing the quality of the work, identifying clear political standards and objectives and developing appropriate indicators to measure performance with respect to these objectives, the Commission proposes a set of ten indicators of the quality of the work that share the following approaches:

- Characteristics of the jobs: (1) objective and intrinsic characteristics, including professional satisfaction, remuneration, earnings in kind and the working day, (2) qualifications, training and the possibility of professional advancement, (3) the content of the work, how the characteristics of the job and the worker coincide;
- The working environment and the labour market: (4) equality between men and women, (5) health and safety, (6) flexibility and safety, (7) job access, (8) conciliation between work and private life, (9) social dialogue and worker participation, (10) diversity and non-discrimination.

Of all these indicators, those associated with essential matters for regional structuring were highlighted, such as salary levels, stability and job security, the presence of women in the labour force and the required level of specialisation.

- The first one, remuneration, is an undeniable quality indicator of the job as an essential objective of employment is to provide a salary that guarantees socially acceptable levels of well-being.
- Professional qualification is included as a dimension of quality not only because it usually involves an increase in salary, but also because it increases the value of the worker within the company, the chances for promotion or for accessing to a better job.
- The third indicator is the job security that the employment provides. Stability is very positively valued as a quality indicator because it enables the workers to organise their life more efficiently beyond the short-term and aspire to advantages such as promotion to which temporary workers are not entitled. In addition, stability increases the confidence and collaboration of the staff with the company and its tolerance to technological change, labour readjustment and new strategies for increasing productivity. A labour force constantly subject to uncertainty and instability becomes alien and disconnected of the dynamics and objectives of the company, and therefore less competitive. At the same time, instability makes investment in human capital inefficient, as the worker has less incentives to become professional in sectors that are very temporary in nature.
- Finally, the parity is an indicator of the degree of compliance of the Organic Law 3/2007 of 22 March (LOIMH) that regulates equal opportunities for men and women in business and guarantees there will be no discrimination due to gender. Besides, it is a key indicator for social structures and rural development.

For the analysis of the main quality factors, estimates were made on the basis of the companies that comprise the population for different qualitative aspects, as described in the following paragraphs.

The average salary for employment in the green subsectors was estimated as the average of the values obtained from the staff costs per employee during 2011 (reported by the companies and extracted from the SABI database), once the dedicated cost of social security paid by the company had been deducted. The resulting value, 16,925 euros, was below the national average (74%) but above the threshold considered for evaluating whether it generates well-being (66%) or not.

The data gathered in the fieldwork stage from the companies that comprise the sample enabled the definition of the characteristics in terms of qualification of the employment (question G4). Using the level of knowledge/specific training in the sector that the employees in the different functional categories must have, the data was classified according to three levels of specialisation. The group of professionals with a high level of specialisation includes designers, technical consultants and installers, and maintenance staff. The second group is made up of professionals who still need a basic education in this sector and must also have other skills in management or sales. Finally, administration staff and operators do not require specific training.

For the renewable energy sector in Aragon, 38.6% of the staff has a high level of specialisation, 18.8% a medium level and 42.6% a low specialisation.

Also in the case of the job security indicator (represented by the continuity of the labour contracting) as a characteristic of quality, in view of the data, we can state that the employment derived from the companies in the renewable energy subsector has a high level of security as 95% of the ongoing employment is full time [25].

At the opposite end of the scale, the presence of women in the labour force in this sector is very low; women make up only 26% of the employment.

In conclusion, the renewable energy sector has good qualitative indicators in terms of both security/stability and levels of specialisation, and reasonably good in terms of salaries (in relation to the cost of living in rural areas). With regard to the very low level of incorporation of women in this subsector, this could be the result of the links of these occupations to maintenance work, and to unreported activities to a certain extent.

5.3. The generation of supplementary income

In the area of quality of life, obtaining supplementary income by the households or families in rural areas, stemming from economic activity supplementary to their main income source, is often the difference between having enough resources to access a certain level of well-being or not. Having the possibility of a second source of income, although lower than the main one, provides a range of advantages in rural areas, not only from an economic point of view, but also from social and human development perspectives.

- Receiving a supplementary income enables the family to achieve higher levels of well-being, as well as more purchasing power.
- The increase in the family's source of income, in addition, positively affects the income of the town, as it gives rise to new investment, the possibility of accessing new services, and an improvement of the infrastructures.
- The start-up of complementary economic activity facilitates the incorporation of women into work. The statistics show the paradox that, although it is essential for women to maintain a working life in rural areas to guarantee its sustainability, the data continues to show very low levels of incorporation, as a result of the few opportunities available.
- The existence of a second source of income enables families to better 'withstand' periods in which the main activity suffers difficulties. This factor is particularly significant in rural areas, where the predominant activities like agriculture and farming are subject to negative events such as the climate instability or falling international prices for agribusiness commodities.
- Finally, the start-up of this type of complementary activity benefits from and at the same time favours the performance of the main activity. The synergies and possibilities of boosting one

activity through the other are obvious, not only making the activities more competitive, but rather, in many cases, opening up markets or niches of unexpected markets.

Supplementary income in rural areas is basically derived from activities that require limited dedication, whether in everyday aspects, or due to its highly seasonal nature. As they are not particularly labour intensive activities, in which case they would be considered the main activities, they must be more or less compatible with the latter.

One of the most suitable models is distributed generation associated with self-supply using renewable energy.

6. Discussion

The renewable energy sector is one of the key sectors for sustainable development and territorial cohesion, still having in Aragon the potential to grow despite the technical maturity reached in some of the technologies used. This does not mean that it cannot continue to grow or improve in terms of productivity or competitiveness, but that it is highly likely that this will not happen abruptly.

Its potential for generation of new employment in the countryside is medium to low although it could be reinforced with actions aimed at encouraging the stages in which the volume of job creation is greater.

The qualitative indicators analysed offer a good perspective in the fields of salary, security and professional specialisation that, in conjunction with the possibility of generating supplementary income, may be an incentive for stabilising the population in rural areas and contributing to regional structuring.

As stated before, quantitative data from surveys were contrasted and complemented with the points of view of 30 'key informants' carefully selected in order to obtain a complete image and establish predictions for its evolution.

All of them agreed that renewable energy has a great potential for territorial cohesion and rural areas development, highlighting in this line the subsector of the biomass and the use of forest residues.

However, experts offer a unanimous answer when they are asked about the main obstacles to the development of the green economy and the implementation of renewables in Aragon. The lack of credit and financing, coupled with a high aversion to risk generated by the current context of economic crisis, dramatically reduce the potential for investment, as well as the willingness to new initiatives.

Along with the economic crisis, the involution of the political and policy context is also a worrying issue due to the intensity and extent of the possible negative effects that might cause. While an involution of the normative and political trend from the European Union in terms of renewables is highly unlikely, the delayed and partial transposition of regulations by State institutions detracts both impact and effectiveness. The regulatory situation, at the national level, is much more uncertain and disturbing, after the approval of some laws clearly counterproductive for the further development and profitability of investments in renewables. Should it be just short-term measures or will finally become a structural trend; it will mark much of the future of the renewables, the green economy and the growth in Aragon.

Another outstanding challenge focuses on the important role of the public sector and the Administration as a 'facilitator' agent. Beyond the need for financial mechanisms and credit that support entrepreneurship and entrepreneurs, it is necessary to establish a more open and favourable administrative context that minimizes the paperwork and administrative burdens. According to many experts, launching environmental innovative initiatives as of today is often expensive, long and complex, and it is very difficult to get the corresponding official recognition.

Finally, the third great challenge is breaking down the barriers arising from the degree of training and this predisposition among enterprises. For many companies, the concept of renewables is a relatively unknown topic, for others the limiting factor is that the period of return on investment

seems too long. The small size of most of the companies, which commitment towards environment is yet insufficient (both at the level of consumption and R&D), are also mentioned as limiting factors.

7. Conclusions and Policy Implications

The energy sector, as a whole, is one of the key sectors for sustainable rural development in Aragon.

The sub-sector of the renewable is indeed the most significant, regarding the evolution of the installed power and its positive impact on employment over the years. Although the ratio direct employment per installed MW has stabilized at around 1.1, the huge natural potential of the territory to increase the presence of renewables, especially if it improves the economic and regulatory context, should be viewed positively.

Today, renewable energy in Aragon can be considered as a mature subsector, with stable employment rates. That does not mean that it can no longer grow or improve in terms of productivity or competitiveness, but it is unlikely it would do so abruptly.

To do this, the qualitative factors obtained should be analysed so as to see how they can be affected in the future by the policies and trends identified:

- Average salary: below the national average (74%) but above the level considered to assess welfare generation (66%).
- Professional specialization: quite diversified among 3 levels (low, medium and high) with certain preponderance of low level once the level of maturity has been reached.
- Job security: very high (95% of full-time continuous employment).
- Gender equality: low (26%), indicative of low presence of women among the workforce.

In conclusion, renewable sector shows good qualitative levels for job stability and specialization and reasonably good indicators wage wise (relative to the cost of living in the countryside). Concerning the very low female participation in the labour force, it might be more frequent in renewable technologies for electricity, closely linked to maintenance work, than in other subsectors such as the efficiency or biomass.

In Aragon, more than 400 companies are engaged in the production, transport and distribution of electric power, with more than 1,500 employees, making up a 5% of regional GDP. In this context, the Government of Aragon has set a strategy from 2013 to 2020, that gives priority to the increase of consumption by renewable instead of fossil fuels (especially oil). This increased consumption would be mainly through more hydraulic plants and wind plants, and, to a lesser extent, in generation by biomass and solar photovoltaic. The objectives of the indirect (in addition to reducing GHG emissions), would increase energy independence and export capacity. The potential of these measures to generate employment becomes evident and has been in fact one of the key factors considered in the planning.

The specific case of biomass presents a considerable scope for development. The Spanish Third National Forestry Inventory assesses the value of forests in each region, according to the value per hectare from three aspects: productive, recreational, and environmental. In Aragon, the recreational value (1 940 euro per ha) is practically the same as the national average while the environmental one is slightly below (4 210 against 5 030 euro per ha). However, the production factor is nearly half of the national average (2 210 against 5 030 euro per ha), emphasizing the room for improvement that remains untapped, especially if we consider that Aragon is the sixth region of Spain in hectares of forested area.

Initiatives raised to achieve such objectives, taking into account their apparent potential for job creation, include the following:

- To boost technologies such as biomass (strongly demanded by the regions and areas with abundant forests).

- To promote investments, such as subsidies in energy efficiency and renewable energy in any of the sectors of industry, transport, construction, public services, agriculture and fisheries, transformation of energy and research.
- To optimize and develop gas and electricity networks:
- To regulate the self- consumption.
- To promote investments with public support for the electrification of rural areas.

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