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A Resource-Based View of Competitiveness in the Wind Energy Sector: The Case of Gran Canaria and Tenerife

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Abstract: This paper proposes a new model to assess the socio-economic potential of two outermost islands of the EU to exploit their resources and capabilities for the sustainable development of the wind energy sector. To that end, a territory competitiveness index is calculated from the resource-based view to assess the socio-economic potential of renewable energy sources in Gran Canaria and Tenerife. We propose a model where local resources and capabilities in the wind energy industry are measured, taking into account different sources of information and methodologies, thus ensuring a rigorous process in the index calculation. In order to quantify the basic resources, for example, a methodology based on a multi-criteria analysis (MCA) with a geographic information system (GIS) is suggested, with the objective of obtaining an indicator called "index of available territorial resources." This index synthesizes the map information through a numerical value that allows integrating the territory resource with other indicators of the model, such as market growth, innovative behavior, firms' concentration, or investment effort by the government. The results of the study show that capabilities development is a key factor to exploit the islands resource endowment in order to achieve a competitive advantage in wind energy.

Keywords: resource-based view; competitiveness; wind energy; island

1. Introduction

Renewable energy sources (RES) are considered a critical factor in the sustainable development of territories to such an extent that the future of those territories largely depends on how RES are generated and used [1–4]. The increasing demand for energy, the environmental issues related to fossil fuel energy, and the social concern for sustainability bring about the necessity to study alternative energy sources. The current energy model is under question, especially when renewable energy is favored for its unlimited feature as well as its more homogenous territorial distribution and it does not generate dangerous waste. In this regard, the Directive 2009/28/EC of the European Parliament and the Council confirmed the previously established goal that renewable energy reaches 20% of energy consumption of the European Union (EU) in 2020, aimed at creating a model of sustainable economic development that favors the safety of the energy supply, competitiveness, and environmental sustainability.

However, it is necessary to emphasize that the analysis of the renewable energy industry in insular territories is an interesting research context. Islands could benefit from economic, social, and environmental gains by switching to renewable energy. First, large electricity systems are not efficient in small islands, because of economies of scale. Second, the population quality of life could be improved because renewable energies based on natural resources are "infinite" and freely available. Finally, the use of green energies is crucial to combat climate change. Nevertheless, as Chua et al. [5] point out, "Despite extensive research works being done on renewable energies, the needs to provide islands with energy alternatives for future development are only modestly discussed in various literatures." Islands that depend upon oil sources to generate electricity are usually non-efficient systems but they can put into value the territory natural resources—such as wind, sun, or sea—in an attempt of self-generating the power demanded by firms and citizens.

The Canary Islands, the only Spanish Outermost European Region, faces the problems of insularity—far from the mainland, fragmented land, etc.—but the right orographic, geographical, and weather conditions allow them to turn those handicaps into sustainable competitiveness due to the significant potential that this archipelago has to generate renewable energy, especially wind power [1]. As Lenzen [4] states, "Wind power is by far the most utilized renewable energy source on islands around the world." In the Canary Islands, only 11,8% of the installed electrical power comes from renewable sources; 42.2% of that power comes from wind sources with approximately 52 wind farms (377 wind turbines). In this line, the use of independent energy sources is essential to achieve the most critical energy objectives in the Canary Islands: the reduction of supply vulnerability, the decrease in external energy dependence, the lowest cost of energy, and the protection and preservation of the environment [1]. Nevertheless, the wind power installed per number of inhabitants in the Canary Islands compared to other countries in the European Union with the same or less wind resource is very low. Thus, the Canary Islands had a meagre ratio of 72 W/inhabitant in 2015 [6], compared to a value higher than 490 W/inhabitant in Spain or 471 W/inhabitant in Portugal [7]. This data reveal the need for a more effective use of this kind of energy in the Canary Islands in order to adjust the available resources to the existing demand in a sustainable way.

At the EU level, regions such as the Canary Islands with specific geographical characteristics have received much "[. . .] regional policy attention and their economic development is considered crucial in helping the EU to attain its important 'territorial cohesion' objective" [8]. However, although islands can be a specific research goal, "[. . .] their analytical relevance in social science does not imply that we need new and different theories and instruments to understand social realities in islands" [9]. Therefore, this research work proposes a model for territory competitiveness assessment revisited from the resource-based view as the combination of location-specific resources and capabilities that can improve the territory's socio-economic development on islands. Correctly, a comparison of the competitive advantage of Gran Canaria and Tenerife in the wind energy sector is carried out. Each island has its autonomous insular government, a premise that has been assumed in the present paper to approach territory competitiveness [10].

In furtherance of the introduction, this paper has four sections. In the second one, the conceptual framework of territory competitiveness is addressed. Third, the proposed model of territory competitiveness in wind energy is presented, along with the methodological aspects of the empirical work, with a detailed explanation of the territory competitiveness index calculation for the wind power subsector. Fourth, empirical results are presented. Finally, we provide a discussion and state the main conclusions.

2. Conceptual Framework

The sustainable development of a territory is closely related to the efficient management of its resources. As Munda and Saisana [11] point out "[. . .] the concept of sustainable development [. . .] defends the idea of harmonization between or simultaneous realization of economic growth and environmental concerns". In this line, Rutkauskas [12] indicates that the competitiveness of a territory depends on its capacity to efficiently use the available resources, as well as on its ability to introduce innovation and positive changes in an environment that can assure sustainability. As Gallardo et al. [13] state, the territory is, in itself, a key strategic asset to achieve competitiveness, being necessary to create capacities to put it into value. Besides, Colletis-Wahl and Pecqueur [14] consider that it is essential to take into account not only active but also latent resources, as the latter could reveal new niches of endogenous productive activity in the territory that strengthens its innovation process. To that end, an estimate of the available resources in the territory is needed, thus enabling strategic management that guarantees sustainability. However, the geographic distribution of the territory's physical resources is not considered in most territory competitiveness research [15–19].

Moreover, the strategies of a territory can be formulated by other resources and capabilities, giving rise to better performance and sustainability in the economic activity [15,20–22]. This circumstance suggests that the resource-based view (RBV) can be a suitable theoretical framework to support the proposal of a territory competitiveness model [23,24]. Territories develop from unique contexts defined by industrial, historical, and local settings as well as by the pattern of long-term investment in resources [25]. In this line, West III and Bamford [24] point out that certain aspects of the RBV are appropriate to be applied to a territory context, because each territory has its bundle of resources that can change over time, giving rise to better performance and higher levels of self-sustainable activity. Specifically, there are three reasons: (a) RBV focus on the competitive advantage generation by creating heterogeneous resources, in combination with the imperfect mobility, imitability, and substitutability of its resource positions; (b) an adequate combination of resources leads to the creation of a territorial capability; and (c) the dynamic capability concept, that suggests that resources and capabilities evolve over time. In this vein, Harmaakorpi [26] affirms, "Regional development strategies should be based on the sound assessment of regional resources, as well as on forming dynamic capabilities aiming to develop the resource configurations in order to form regional competitive advantage."

The model proposed in this paper is based on the concept of territory competitiveness conceived as the appropriate combination of territory-specific resources and capabilities, in order to improve socio-economic development and increase the quality of life of its inhabitants. This definition supports Silva's [27] and Azena's [28] proposals that territory development should be grounded on a process that takes advantage of its own natural, human, institutional, and organizational sources, in order to transform local productive systems and to improve the life quality of citizens.

In this research, basic and complementary resources are distinguished. Kitson et al. [29] point out that territorial differentiation is due to the external assets that are directly or indirectly exploited by the local firms, thus improving their effectiveness, innovation, flexibility, and dynamism, and therefore the territory productivity and competitive advantage. However, existing resources are not enough to ensure territory development; additionally, territorial capabilities are needed in order to exploit opportunities and to support the creation of competitive advantage, throughout knowledge, learning, and local creativity [22,30,31]. With the aim to determine the capabilities in a territory, the national diamond by Porter [32] has served as a starting point. In this case, three of its angles (demand conditions; firm strategy, structure and rivalry; and related and supporting industries) have been adapted to the proposed model through three elements: demand, innovation, and proximity. Furthermore, government—under the term "governance"—has also been considered because it influences the effectiveness with which resources become outcomes and vice versa [15].

Additionally, the proposed model supports the idea that a high productivity value might not correlate with a strong territory competitive advantage; instead, this competitive advantage should materialize through both social and economic territorial performances. Therefore, although the best outcome indicator for territory competitive advantage is productivity in terms of Gross National Product (GNP) per capita [15,18,19,33–37], it is also necessary to include a social perspective, because the life quality of citizens and social welfare goes beyond the image of relative opulence reflected in the GNP [28,38–41].

Based on this model of territory competitiveness, an assessment of the bundle of territory basic and complementary resources, as well as capabilities, is required to determine a value that represents the competitiveness. Moreover, an evaluation of the socio-economic outcomes has to be carried out for a better understanding of competitiveness linked to those resources and capabilities. In this respect, the outcomes provide information about the efficient use of resources and capabilities (those territories that use fewer resources to obtain better performance), as well as it effective deployment (goals achievement). This analysis of the available resources and capabilities, as well as the outcomes achieved, should be used to establish different strategies that enable a sustainable improvement of territory competitiveness.

Although the concept of territory competitiveness has received much attention [42], the debate about the concept and the variables for its measurement remains open, posing an interesting subject of study both from a theoretical and an empirical perspective [43–45]. This paper makes a significant academic contribution to the field by providing a clearer and more precise distinction between the concepts of basic resources, complementary resources, and capabilities, which represent the key factors to determine the competitiveness of a territory. This way, it gives a new perspective from the resource-based view to the academic debate concerning how territory competitiveness can be conceptualized and measured. Moreover, since territory competitiveness has gained importance in government circle, policymakers can benefit from this new holistic strategic model for the assessment of territory competitiveness with the purpose of developing policies which promote and encourage the sources that impulse socio-economic development of territories.

3. Proposed Model of Territory Competitiveness in Wind Energy and Research Methodology

In this section, we present a holistic strategic model for the assessment of territory competitiveness, revisited from the resource-based view (see Figure 1). The proposed model makes it possible to carry out a comparative analysis of the territory competitiveness of two or more territories in the wind energy sector based on the local resources and capabilities. Nevertheless, it also evaluates the ability of the key players to deploy the resources and capabilities towards socio-economic development in order to maintain or increase the quality of life of its inhabitants in terms of sustainability concerns.

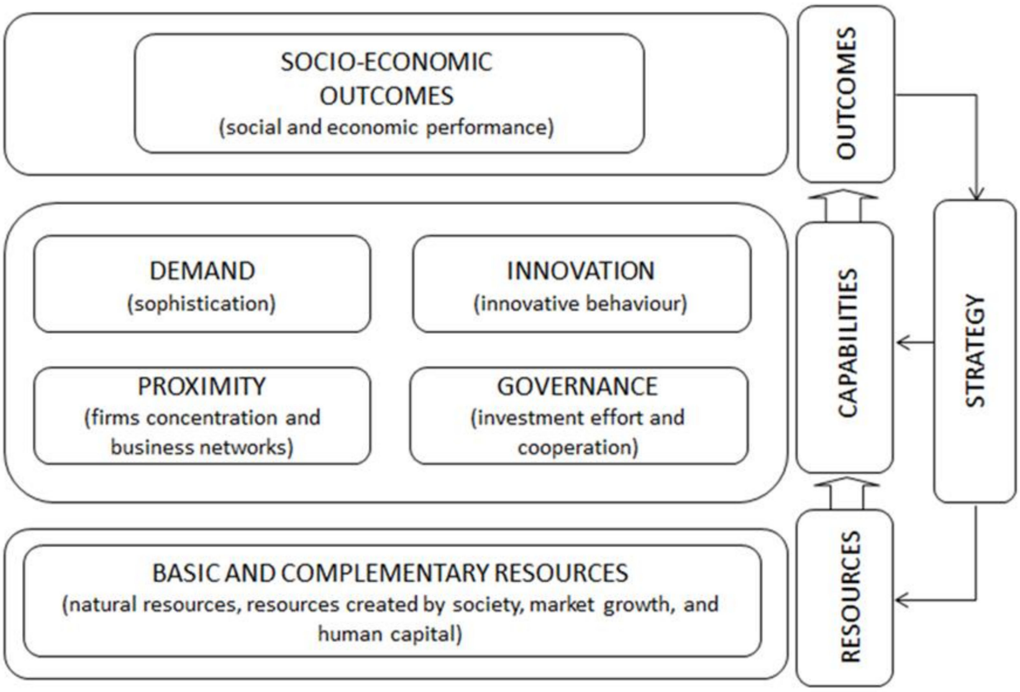

Figure 1. Model of territory competitiveness from the resource-based view.

3.1. Research Context

In this research, we empirically test the proposed model to compare the competitiveness in the wind energy sector of two insular territories, Gran Canaria and Tenerife, in the Canary Islands, one outermost region of the European Union. This archipelago is in the North East of Africa, between latitudes 27°37′ and 29°5′ N and longitudes 13°20′ and 18°10′ W. Its geographic fragmentation, its distance from the large energy production plants (located at 1000 km from mainland Spain), and the lack of conventional energy resources have created an important dependence on oil importation [46]. In this line, the use of independent energy sources is essential to achieve the most critical energy objectives in the Canary Islands: the reduction of supply vulnerability, the decrease in external energy dependence, the lowest cost of energy, and the protection and preservation of the environment [1].

3.2. Data and Variables

3.2.1. Basic Resources

Apart from wind speed, other factors may favor the development of wind energy in the territory. In order to quantify this variable, a methodology based on a multi-criteria analysis (MCA) with a geographic information system (GIS) is suggested, aimed to obtain an indicator called available territorial resource index (see Figure 2). In the following paragraphs, we explain the stages of the proposed methodological framework.

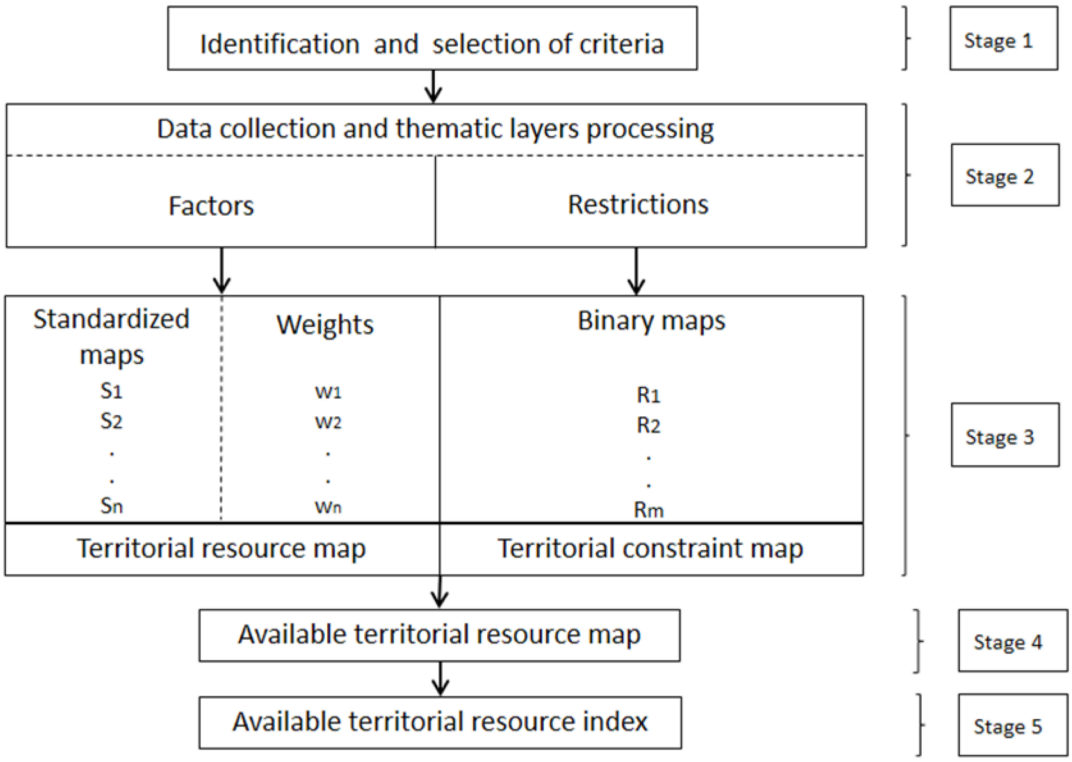

Figure 2. Methodology for available territorial resource map and index.

Stage 1: Identification and selection of criteria. The process starts with the identification and selection of the critical criteria for the evaluation of the territory resources involved in the development of wind energy (Table 1). In this sense, the literature suggests that resources should be classified into factors that favor the wind energy [47–56] and constraints [47,48,51,52,54,57–60]. These data stemmed from GRAFCAN, the official supplier of geographical information in the Canaries.

Stage 2: Data collection and thematic layers processing. In the second stage, the criteria are added to the GIS via different thematic layers from the geo-information available in the Spatial Data Infrastructure (IDECanarias).

In stages 3 and 4, the scheme presented in Figure 3 will be followed.

Table 1. Classification of factors and constraints.

Factors		
Wind speed	Less than 4 m/s = 0	More than 10 m/s = 1
Slopes	More than 60% = 0	Less than 10% = 1
Visual impact	Visible from more than 4 villages = 0	Visible from 0 villages = 1
Proximity to electricity lines	More than 2000 m = 0	Less than 300 m = 1
Land use	Incompatible area = 0	Compatible area = 1
Proximity to urban areas	More than 5000 m = 0	Less than 1000 = 1
Proximity to road access	More than 2000 m = 0	Less than 300 m = 1
Constraints		
Protected areas	Perimeter	
Water reservoirs	Perimeter	
Airports	Perimeter	
Roads	Width	
Ravines	5 m from public water domain	
Remote housing	A perimeter of the built-up areas	
Population area	Perimeter	
Main roads	20 m from the center axis	
Sea–land limits	100 m inland from the shore	
Military areas	Perimeter	

Stage 3: Territory resource map and territory constraint map. In order to create the territory resource map (TRM), the thematic layers adopt a raster format. As these layers have different measurement units, it is necessary to standardize them in order to carry out a joint analysis. In this case, a fuzzy standardization is used (between the values 0 and 1). To this end, it is necessary to identify the critical point of transition between 0 and 1 in each factor (Table 1). Furthermore, not all factors influence with equal weight. In order to assign this weight, we create a square matrix where the pairwise comparison of the factors can be carried out [61]. We assign a value to each element of the matrix, which represents the relative importance of the factor in the row and column, using a scale from 9 (most importance) to 1/9 (least importance). A consistency ratio of 0.08 is obtained; a value below 0.1 is suitable [62]. Once the accurate weights are calculated, each pixel takes on a suitable value through the linear weighted summation [63] of the thematic layers that represent the different factors. In the territory resource map (see Figure 4), the most suitable areas will take on a value closer to 1, and the least suitable areas will take on values closer to 0.

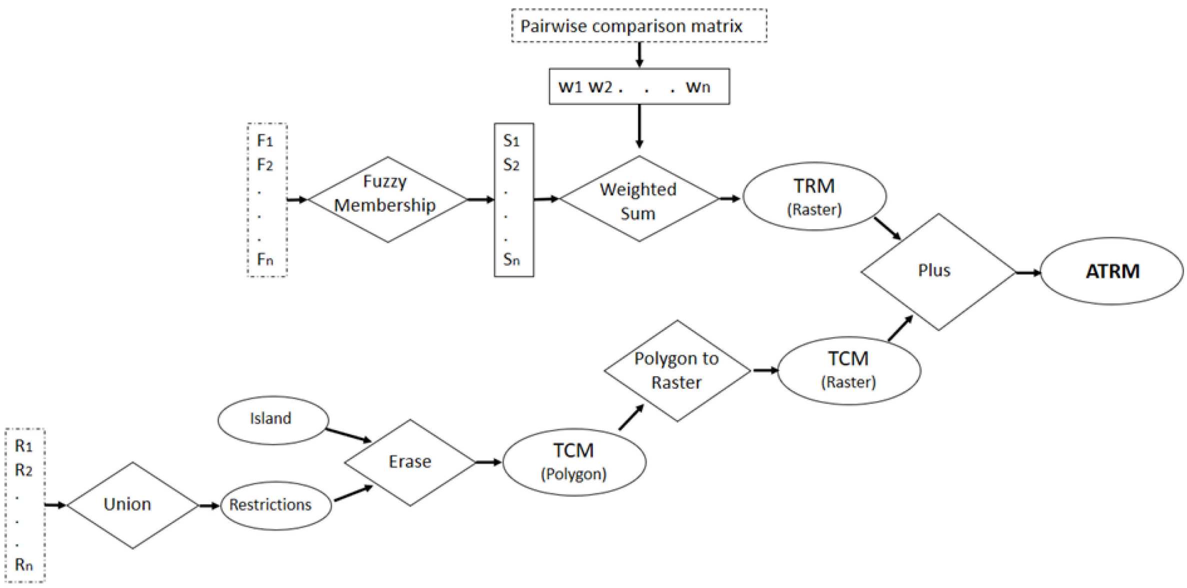

Figure 3. Geographic information system (GIS) model for stages 3 and 4.

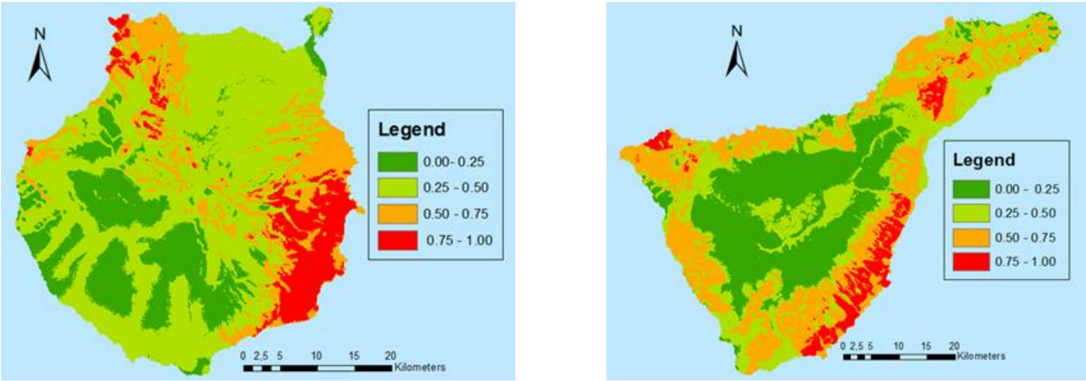

Figure 4. Territorial resource map for the wind energy sector of Gran Canaria and Tenerife.

The next step in the process is the elaboration of the territory constraint map (TCM). The thematic layers that make up this map are in a vector format. This format defines and measures accurately the surface of the areas that are suitable for the activity researched. Because of its dichotomous nature, its standardization is carried out through a Boolean method. The territory constraint map identifies the area of the land suitable for the development of wind energy, considering the constraints established (see Table 1).

Stage 4: Available territory resource map (ATRM). The objective of the fourth stage is to obtain the ATRM (see Figure 5). In this document, we synthesize the influence of all the factors based on their assigned relative weight. The application of constraints accurately delimits the territory area susceptible to use. To facilitate visualization, the land is classified in terms of four suitability levels (see Table 2): poor (0.00–0.25), moderate (0.25–0.50), suitable (0.50–0.75), and highly suitable (0.75–1).

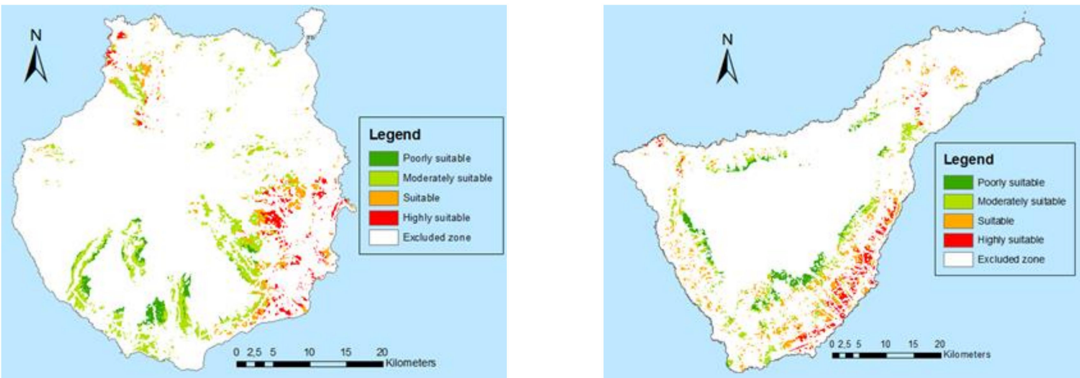

Figure 5. Available territorial resource map (ATRM) for the wind energy sector of Gran Canaria and Tenerife.

Table 2. Suitability levels of land for wind farm siting.

		GC		TF	
Suitability	**Pixel value**	**Area (ha)**	**(%)**	**Area (ha)**	**(%)**
Poorly suitable	0.00–0.25	1751.13	11.80	3365.23	22.68
Moderately suitable	0.25–0.50	8320.31	56.08	5912.66	32.12
Suitable	0.50–0.75	2851.07	19.22	6421.49	34.88
Highly suitable	0.75–1.00	1914.55	12.90	2710.34	14.72
Total		14,837.06	100.00	18,409.72	100.00

Stage 5: Available territory resource index (ATRI). The process culminates with the calculation of a numerical value: the ATRI. This index enables us to carry out a comparative evaluation among territories. This index is obtained multiplying the arithmetic mean of the value that the ATRM pixels take on by the available areas obtained from the TCM, according to (1):

$$\text{ATRI} = \frac{\sum_{i=1}^{n} CRT_i}{n} * \text{S} = \text{CRT} * \text{S} \quad (1)$$

where CRTi is the value that represents the quality of the territory resource of each pixel that the GIS calculates for each island, n is the number of pixels of the available area, and S is the available surface area.

3.2.2. Complementary Resources

First, the average annual growth of electrical energy network production is used to determine market growth [16,17]. Second, we measure the human capital variable by the number of workers in wind energy companies and by the percentage of university students who study engineering degrees associated with wind energy [64,65].

3.2.3. Capabilities

Demand

Three indicators measure the sophisticated demand. First, the ratio between the amount of electrical energy produced by wind power and the total amount of electrical energy in the network consumed on each island. Second, the percentage of high school and university graduates over the total population, as Moon et al. [19] and Sledge [66] state that the sophistication of demand is positively associated with the educational level. Third, the percentage of homes that separate rubbish, as the degree of people's commitment to the environment may involve a favorable attitude toward renewable energies [23].

Innovation

Santos [67] indicates that the regional innovation systems have an essential role to play and offer possibilities of producing a regional competitive advantage. The indicators that could provide a good measurement of innovation behavior are the following: the number of patents for the sector [68], the number of final degree works associated with wind energy, and the number of publications in scientific journals associated with wind energy at the University of Las Palmas de Gran Canaria and the University of La Laguna [69–71].

Proximity

There is a broad consensus that firms are more competitive when they are agglomerated [72], as they exploit certain advantages associated with relations to other companies and agents directly or indirectly involved in such activity [32,73]. However, firms' concentration is not enough to improve territorial capability, as the creation of business networks is also necessary to increase the added value and create synergy [74–77]. This territorial capability is measured by two variables: firms' concentration and business networks. The firms' concentration is measured by the location index, calculated through the method of the nearest neighbor using GIS [78]. Business networks are measured through the network effect as a combination of network strength and openness [75]. This information was obtained through a survey. The answer rate was 57%, with an error of 8.7%.

Governance

Government is a decisive factor for the renewable energy sector because without governmental support, its development would be slower [79,80]. In this study, governance is measured by two variables: investment effort and cooperation. The first one is the percentage of public investment planned in each island in comparison with the whole for the Canary Islands [81]. Three indicators assess cooperation: (a) coordination between public institutions and wind energy sector firms, (b) effectiveness of public institutions in the management of the wind energy sector, and (c) promotion of the sector by public institutions. These indicators were also obtained through the questionnaire sent to the firms in the sector.

3.2.4. Socio-Economic Outcomes

This variable is measured through three indicators: productivity, market share, and social outcomes. First, on the basis of the research by Gardiner et al. [33], the outputs of territory competitiveness should be measured through productivity. In this industry, the equivalent hours, which evaluate the energy produced in the wind farms per installed unit of power (kWh/kW), turn out to be an excellent indicator of productivity. Moreover, we consider two other productivity indicators: (a) reduction of energy dependence on oil products, measured by the number of tonnes of oil equivalent (toe) that the territory saves as a consequence of using wind energy; and (b) saving in energy costs, measured by the proportion of wind energy produced in relation to the total energy, assuming a lower cost of wind energy. The industrial penetration of wind power is measured by means of (a) the wind power installed per number of inhabitants (W/inhabitant), which represents the importance of the sector, and (b) the percentage of wind energy firms, which shows the specific importance of the sector in the economy of the territory. Finally, social outcomes are measured through (a) the reduction of CO2 emissions in the atmosphere because of wind energy use, and (b) the company survival rate as a measure of its potential for sustainable economic growth.

In Appendix A, there is a summary of the indicators used to measure the different variables, as well as the sources of information for each indicator.

4. Results

Table 3 shows the values of the different resources and capabilities in Gran Canaria and Tenerife. As each indicator has a different measurement unit, they should be unified on a 100 basis. For each indicator, the value 100 is assigned to the maximum ranked territory, while an equivalent value is given to the remaining ones [19]. In the case where the variables are a combination of indicators, a weight is assigned to each of them, taking into account the opinion of industry and academic experts interviewed and by using a Saaty matrix [61]. This procedure is based on a square matrix with the indicators to be weighted. In this way, a comparison matrix between pairs of indicators is established, comparing the importance of one against the others. Subsequently, the priority vector and the weights of each indicator are determined. The weights obtained are rounded to multiples of five.

Table 3. Standardized values of resources capabilities in Gran Canaria (GC) and Tenerife (TF).

Variables	GC	TF	GC	TF	Weights (%)	GC	TF
Basic resources							
ATR	6473	8853	73.11	100.00	100	73.11	100.00
Complementary resources							
Market growth	3.44	4.95	69.49	100.00	15		
Human capital1	30.9	19.3	100.00	62.46	25	95.42	64.84
Human capital2	312	178	100.00	57.05	60		
Potential of resources:						168.53	164.84

Table 3. *Cont.*

Variables	GC	TF	GC	TF	Weights (%)	GC	TF
			Capabilities				
Demand							
Sophisticated demand1	6.64	3.86	100.00	58.13	60		
Sophisticated demand2	33.5	32.7	100.00	97.61	30	100.00	72.84
Sophisticated demand3	61.12	53.06	100.00	86.81	10		
Innovation							
Innovative behaviour1	8	1	100.00	12.50	55		
Innovative behaviour2	18	3	100.00	16.67	15	100.00	20.62
Innovative behaviour3	16	6	100.00	37.50	30		
Proximity							
Firms' concentration	1.86	1.33	100.00	71.29	30	100.00	82.74
Business networks	3.32	2.91	100.00	87.65	70		
Governance							
Investment effort	30.01	38.09	78.79	100.00	60		
Cooperation1	1.82	2.00	91.00	100.00		86.07	98.58
Cooperation2	2.00	1.90	100.00	95.00	40		
Cooperation3	2.12	2.00	100.00	94.34			
		Potential of capabilities:				386.07	274.78
		Total potential:				554.60	439.62
		GC = Gran Canaria; TF = Tenerife				100	79.26

Finally, combining the weights with the indicator values, an assessment for each one of the resources and capabilities is obtained. The results in Table 3 show that, although the two islands have a similar potential of resources (GC: 168.53; TF: 164.84), Tenerife has a better available territorial resource for the development of wind power, while Gran Canaria has more complementary resources, mainly due to its better endowment of human capital. As far as the capabilities are concerned, Table 3 shows that Gran Canaria has a higher potential of capabilities than Tenerife (GC: 386.07; TF: 274.78). Specifically, Gran Canaria shows a better performance in the proportion of renewable energy over the total electrical energy, as well as in innovative behavior indicators. Tenerife enjoys better governance because, although Gran Canaria outperforms Tenerife in terms of management efficiency and promotion of the industry by the insular government, the latter has received more funds for the development of the sector and it also reaches a sounder coordination between the administration and industry firms. Concerning the total potential of resources and capabilities, Tenerife only possess 79.26% of those of Gran Canaria.

With this evaluation, we draw a radial graph that defines a polygon for each island analyzed. Taking as a reference the national diamond [32], it is assumed that the critical factors of territory competitiveness are related to each other with a mutual influence. Thus, "[. . .] their relationship is better characterized by a multiplicative combination than by an additive combination. A country in which all four determining factors show an average value is more competitive than a country where two values are high and two are low" [16]. In this case, the measure of the competitiveness for each island is done with a six-vertex polygon which represents the combination of its resources and capabilities (Figure 6).

The territory resources and capabilities assessment is then calculated as a ratio between the polygon area that represents each island and the maximum polygon area, with a rank of 100 in all the factors [19], as shown in Table 4. These results reveal that Gran Canaria achieves better resources and capabilities assessment (100.00) compared to Tenerife (63.12).

Table 5 shows the values of the outcomes in Gran Canaria and Tenerife. Again, as each indicator has a different measurement unit, the indicators should be unified on a 100 basis. Moreover, as the outcomes have several indicators, a weight is assigned to each of them using the pairwise comparisons method and the opinions of experts. Finally, combining the weights with the indicator values, an assessment for each one of the outcomes is obtained, showing that Gran Canaria has an outcome index over 40 points higher than Tenerife (GC: 100.00; TF: 58.04) due to a higher value in all the indicators. Differences are mainly found in industrial penetration, followed by productivity and social outcomes.

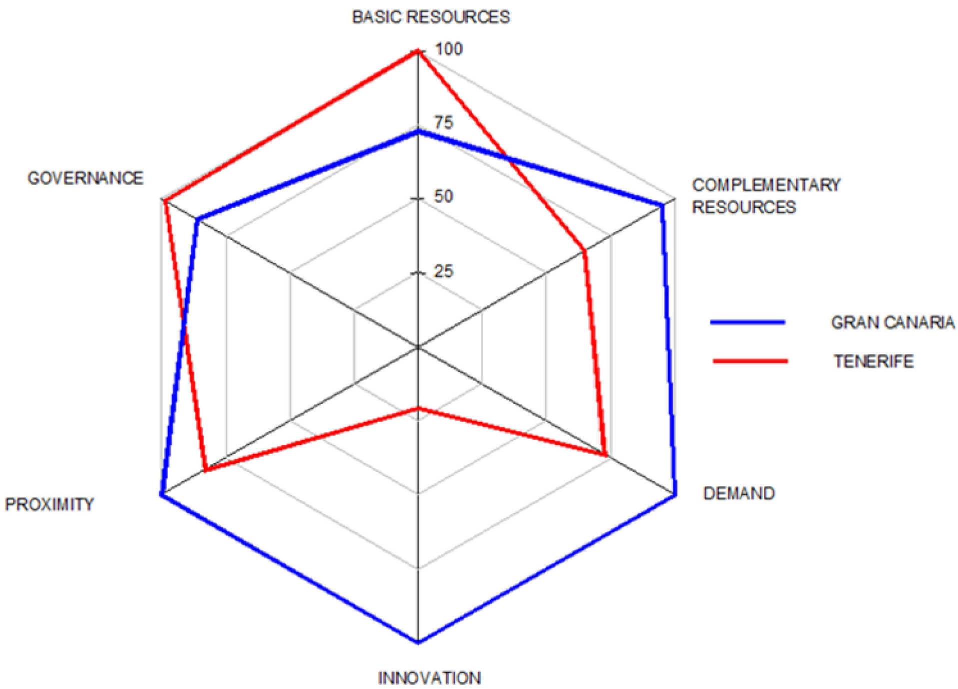

Figure 6. A comparative graph of resources and capabilities for Gran Canaria and Tenerife.

Table 4. Resources and capabilities assessment in Gran Canaria and Tenerife.

	GC	TF	GC	TF
Polygon area	22,245.3	14,040.4	100	63.12

Table 5. Outcomes assessment in Gran Canaria and Tenerife.

Variables	GC	TF	GC	TF	Weights (%)	GC	TF
Productivity1	2.52	2.10	100.00	83.26	50		
Productivity2	18.29	6.61	100.00	36.11	20	100.00	59.67
Productivity3	5.74	2.07	100.00	36.06	30		
Social outcomes1	167.21	60.39	100.00	36.11	60	100.00	61.67
Social outcomes2	5	5	100.00	100.00	40		
Industrial penetration1	0.13	0.08	100.00	61.54	50	100.00	52.77
Industrial penetration2	92.76	40.81	100.00	44.00	50		
Total outcomes						300.00	174.11
GC = Gran Canaria; TF = Tenerife						100.00	58.04

On the basis of the same criterion used with resources and capabilities, mutual influence between outcomes is also assumed. Therefore, this relation is better represented by the value of a polygon area (see Figure 7).

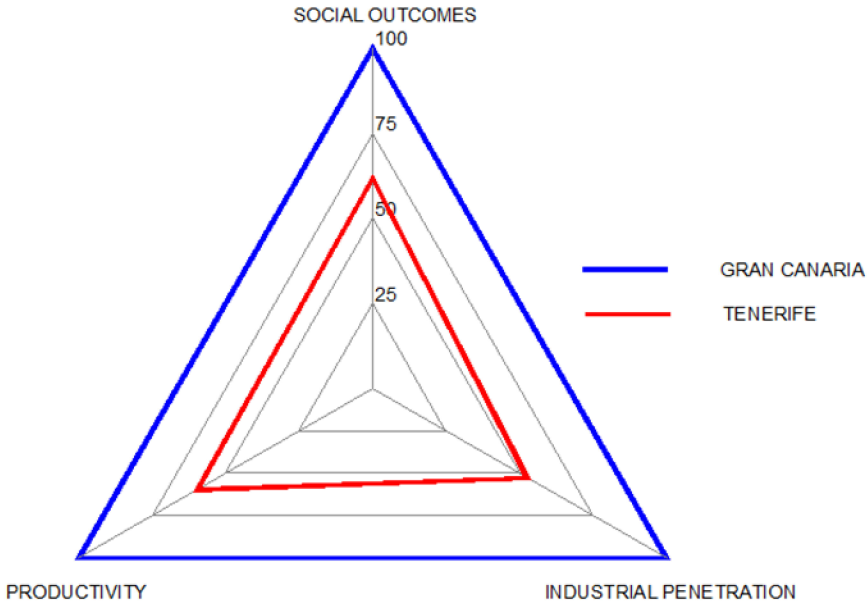

Figure 7. Comparative outcomes for Gran Canaria and Tenerife.

The territory outcomes assessment is then calculated as a ratio between the triangle area that represents each island and the maximum triangle area, with a rank of 100 in all the factors [19], as shown in Table 6.

Table 6. Outcomes assessment in Gran Canaria and Tenerife.

	GC	TF	GC	TF
Polygon area	12,990.4	4366.1	100	33.61

Once all the indicators in the model have been quantified (resources, capabilities, and outcomes), the method goes on to calculate a territory competitiveness index as the ratio between the value of outcomes and the value of resources and capabilities for each island. Thus, Gran Canaria obtains a territory competitiveness index of 1 (100/100), and Tenerife gets an index of 0.53 (33.61/63.12). This result means that Gran Canaria obtains nearly twice the performance of Tenerife with regards to resources and capabilities.

5. Discussion and Conclusions

This study proposes a model to evaluate the competitiveness of two insular territories in the wind energy sector from the resource-based view. The assessment of all the available resources and capabilities is particularly sensitive in islands where a structural handicap that hinders their social and economic development exists [82,83]. This insular disadvantage is notably significant for the energy supply as it depends on the imports of oil products [1–3]. The model has been empirically tested carrying out a comparative analysis of Gran Canaria and Tenerife, two outermost European islands. On the basis of the assumptions of the proposed model, those territories that reach better performance with less resource endowment are considered more competitive. Compared to Tenerife, the results show that Gran Canaria obtains almost a twice as good performance from the resources located in the territory. The reason for this difference is that the sector of wind power on the island of Gran Canaria has a better resource endowment, mainly complementary resources, while the basic resource value is lower than in the island of Tenerife. Concerning capabilities, Gran Canaria outperforms Tenerife due to demand, innovation, and proximity. However, in Tenerife, there is a more robust governmental and institutional support. Therefore, we can affirm that capabilities development is a key factor to exploit the islands resource endowment in order to achieve a competitive advantage in the wind energy sector.

This paper makes a significant academic contribution by providing a clearer and more precise distinction between the concepts of basic resources, complementary resources, and capabilities, which represent the key factors in determining the competitiveness of a territory. Thus, policymakers can benefit from this new competitiveness approach to formulate strategies and policies to foster better outcomes in their geographic areas. Concerning the territory resource, this research has an important practical implication. Based on the information from the ATRM and the ATRI, stakeholders can formulate specific strategies for those areas with better conditions for the development of a particular economic activity. In this vein, the assessment of all the available resources is particularly crucial in insular territories where the need to assign the best use to the existing limited land is critical in order to ensure its sustainability [2,4,84].

Furthermore, the proposed methodology permits the updating of information independently. This fact facilitates the tracking of resources over time without the need to repeat the whole process each time. Therefore, from the information that the empirical application of the model provides, a land-use policy that strengthens those areas with better conditions for the development of wind power industry can be formulated.

Moreover, the model goes beyond calculating a territory competitiveness index to rank the territories, as it also relates such index with the socio-economic outcomes achieved [15], thus evaluating the ability of the territory to exploit its resources and capabilities for the sustainable development of the wind energy sector. Hence, this research is in line with Praene et al. [85], who state that "[. . .] the deployment of any project in the energy field has to take into account economic, technological and social aspects in order to prove sustainable". Therefore, the results of this research enable strategic decision-making aimed at: (a) environmental preservation, perfectly delimiting the areas where it is viable to place a particular activity; (b) economic viability, classifying the territory according to its suitability for economic development; and (c) social equity, making it possible to plan between needs and available resources throughout the territory.

Finally, some limitations of the present work must be recognized. First, it is necessary to consider that certain territorial variables of resources, capabilities, and outcomes have not been included in this work, so future research could contribute to improving the proposed model. Because the territory rankings that appear by applying the proposed methodology are for a specific research context, it would be interesting to replicate the model within other territories and sectors. In this sense, further studies could be carried out on other types of renewable energy industries such as photovoltaic, biomass, bio-fuel, or biogas power. To this end, indicators should be re-designed so that they get closer to the selected context configuration. Additionally, this methodology is useful to the study of synergies between different, potentially complementary sectors (e.g., tourism, agro-food, commerce, transport, and so on). Taking advantage of the possibilities that the integration of multi-criteria analysis with geographic information systems offers, other applications are possible to evaluate a territory and reveal which areas can be suitable for the development of synergies between different activities.

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Appendix A. Sources of Information and Raw Values

Variables	Indicators	Sources
Basic resources		
Available territorial resource (ATR)	The available territorial resource index	– State regional laws plans – Academic literature on the setting up of wind facilities – Wind resource of the Canary Islands (Canary Technological Institute) – Mapping (GRAFCAN) – Infrastructure of Spatial Data of the Canary Islands (GRAFCAN) – Recommendations by the International Civil Aviation – Google Earth – Online information about the associations of wind firms
Complementary resources		
Market growth	Annual growth of electrical energy production (%) from 2000 to 2011	Energy data (Government of the Canary Islands)
Human capital1	University students of engineering degrees associated with wind energy (%) from 2005 to 2009	Annual reports of the universities (ULL and ULPGC)
Human capital2	Workers in wind energy companies in 2011	– Questionnaire – SABI (database) – Cluster RICAM – Online information about the companies
Capabilities		
Demand		
Sophisticated demand1	The ratio between the amount of electrical energy produced by renewables sources and the total amount of electrical energy from 2000 to 2011	Energy data (Government of the Canary Islands)
Sophisticated demand2	High school university graduates (%) from 2001 to 2007	– Canary Statistics Institute – Annual reports of the universities (ULL and ULPGC)
Sophisticated demand3	Homes that separate their rubbish (%) from 2001 to 2007	Canary Statistics Institute
Innovation		
Innovative behaviour1	Patents for the sector from 2001 to 2009	Spanish Agency of Patents Trademarks
Innovative behaviour2	Final degree works associated with wind energy from 2003 to 2010	Annual reports of the universities (ULL and ULPGC)
Innovative behaviour3	Publications in scientific journals associated with wind energy from 2003 to 2009	– Annual reports of the universities (ULL and ULPGC) – Annual research reports of the universities (ULL and ULPGC)
Proximity		
Firms' concentration	Location index	– Cluster RICAM – Online information about the companies – Google Earth – Administrative Record of electricity facilities (Ministry of Industry, Tourism Commerce) – Mapping software (GRAFCAN) – Official Bulletin of the Canary Islands – General Direction of the Land – Mapping (GRAFCAN) – Record of wind farms in the process of authorization (Government of the Canary Islands)

Variables	Indicators	Sources
Capabilities		
Business networks	Network effect	Questionnaire
Governance		
Investment effort	Public investment planned in each island in comparison with the whole for the Canary Islands (%) from 2006 to 2015	Energy Plan of the Canary Islands 2006–2015
Cooperation1	Coordination between public institutions and wind energy sector firms (scale 1–5)	Questionnaire
Cooperation2	Effectiveness of public institutions in the management of the wind energy sector (scale 1–5)	Questionnaire
Cooperation3	Promotion of the sector by public institutions (scale 1–5)	Questionnaire
Outcomes		
Productivity1	Equivalent hours (kWh/kW) in 2008	Energy data (Government of the Canary Islands)
Productivity2	Tonnes of oil equivalent (toe) saved in 2008	Energy data (Government of the Canary Islands)
Productivity3	Wind energy produced with respect to total energy in 2008	Energy data (Government of the Canary Islands)
Social outcomes1	Reduction of CO_2 emissions in 2008	Energy data (Government of the Canary Islands)
Social outcomes2	Company survival rate	Questionnaire
Industrial penetration1	Wind energy firms (%)	– SABI (database) – Cluster RICAM – Online information on the companies
Industrial penetration2	Wind power installed per number of inhabitants (W/inhabitant) in 2014	Energy Plan of the Canary Islands 2006–2015

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