Renewable Energy and Landscape Quality - An Exploratory Approach in the Algarve Region

Sandra Estrela

Instituto Superior Técnico, Universidade de Lisboa, Av. Rovisco Pais, 1049-001 Lisbon, Portugal

sandra.estrela@ist.utl.pt

Abstract: The main purpose of this work is to understand the tourists' perception of the visual impact on the landscape quality caused by the introduction of renewable energy infrastructures, namely wind turbines and photovoltaic panels. The methods of this study were based on inquiries done in person, with resource to photographic simulations of four types of landscape in Monchique county. The results have shown that the respondent subjects prefer the original landscape (without the introduction of renewable energy infrastructure), in comparison with the simulated landscapes (with renewable energy infrastructure) and in those, the subjects always prefer the ones with less intense construction of both wind turbines and photovoltaic panels. We concluded still that between the two pieces of equipment, which are highlighted in this study, inquired people had in general a preference for wind turbines over photovoltaic panels.

KEYWORDS: Tourists; renewable energy; visual impact; landscape; perception; Monchique.

Introduction

The massive use of fossil fuels by modern society as contributed to the increase of greenhouse gas emissions, which in turn are responsible for global warming injuring economic and ecologic systems in various ways **(Häyhä et al., 2010)**. The International Quioto Protocol and the work carried out by IPCC (Intergovernmental Panel on Climate Change) have progressively put forward evidences that global warming is the most urgent challenge that humanity presently faces. The national and international energetic policies are at the core of the strategies being developed to undertake this challenge, as a result it is verifiable that the use of renewable energies has been greatly increasing in developed countries but also in many less developed countries **(Nadaï et al., 2010).**

In Portugal, there has been a noticeable increase in investment policies in renewable energies. This investment has come as an answer to politic and economic pressure caused by the goals imposed by the European Union in respect to the production of energy from renewable sources. In 2010, a goal of attaining a production of 45% of electricity from renewable sources was set, and attained **(Eurostat, 2011).**

In spite of the positive aspects resulting from the countries investment in renewable energies, namely, the fight against climate change, pollution reduction and decrease of dependence on foreign energy sources, the increasing renewable energy infrastructure has caused a lot of controversy. “ao nível local e situado os conflitos tornam-se visíveis (destruição da paisagem, impactos nocivos nos ecossistemas rurais, nas actividades turísticas, na saúde…)” **(Delicado et al., 2013, pp. 11)**.
The quote reads as follows: at the local levels conflicts become apparent (landscape destruction, hill impacts on rural ecosystems and in touristic activities as well as on public health…).

In practice, the EIS (Environmental Impact Study) and the EINCS (Environmental Impact Study) are the main instruments used in Portugal to regulate the installation of structures potentially harmful to environment. However, in both documents, the approach to landscape quality is of an expert nature, lacking an evaluation by the public in general.

There is competition between the energy and tourism sector for the landscape, albeit with different interests. The landscape is considered an asset for various types of tourism, even for health tourism and wellness in which the user wants just to enjoy a "short break". The simple fact that the tourists have a sea or mountains view is an attractive factor to them. Although, the energy sector also competes for this same landscape, especially for their biophysical aspects (soil) in terms of the support they provide to their renewable energy infrastructure, rather than the aesthetic sense and emotions that transmits.

The sustainable future of our country depends on the continued implementation of renewable energy infrastructure, however it’s vital to take into account the relation “energy-landscape-tourism” and its inherent conflicts, and through close and careful analysis try to understand their root, while at the same time search for initiatives to decrease them.

According to **Kienast et al., (2012)** the management of the conflicts between renewable energies and tourism, in regards to impacts on the landscape, needs to include further information about people’s perception. This is why this dissertation is urgent, since its objective is to try to understand the perception, relative to the visual impact of renewable energy infrastructure on the landscape, of a particular group of the public, is urgent.

Theoretical background

The recognition of renewable energy sources by society has been made obvious by the importance this have in diverse activity sectors, namely in industry, transportation, domestic but most of all in the energy production sector **(PNAER, 2009).** Currently Portugal is one of the European Union countries with the highest share of energy consumption from renewable energy sources (23.2%). **(Eurostat, 2011).**

Algarve is a region that has been investing on renewable energies; the fact that in 2010 its production of energy was almost exclusively from renewable sources (98.6%) attests to that. In 2012 the installed power output from wind generators was in 4th out of the 7 regions in the country, and the installed power output from photovoltaic energy was about 15% of the national total (2nd in the country behind Alentejo) **(CCDR Algarve, 2013).** Wind and solar energy as well as biomass energy are regarded as the sources of energy with the highest potential for this region **(Goncalves, 2014).**

Algarve is a region especially directed towards the tertiary sector, where the touristic activities represent a major part of all activities **(Cruz, 2010).**

According to **Puiu et al. (1974)**, tourism is one of the main beneficiaries of the landscape, seen that it provides a platform for the undertaking of touristic activities. The quality and typology of landscapes establish the premises for a given type of touristic activity, incentivizing or inhibiting the development of that economic sector **(Puiu et al., 1974).** It can be said that there is a double relation between the concepts of tourism and landscape **(Figure 1)**. The quality of landscape makes it either more or less attractive to the development of tourism and is at the same time crucial in its typology. On the other hand, tourism takes advantage of the landscape as a support for infrastructure related to its activities altering the quality of the landscape in either a positive or negative way.

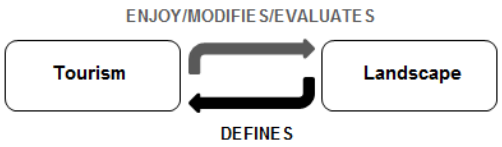

Figure 1: Double relation between tourism and the landscape.

Methodology

The region chosen to perform this study on was Algarve; however, as a case study, a county was picked in an illustrative way, at a local scale, because this is the closest to the day-to-day life and is therefore more easily understood by the population. The selection process for the case study took into account the potential conflict between landscape, energy infrastructure and tourism **(Figure 2)**.

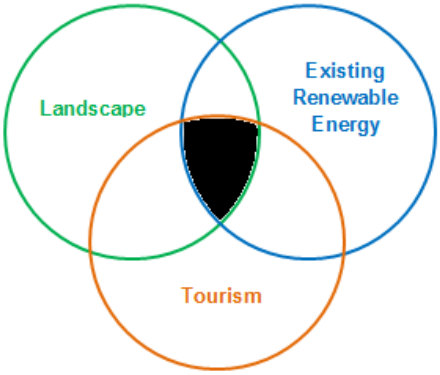

Figure 2: Diagram representative of the region of potential conflict.

The process which allowed for the creation of the necessary conditions for the selection of the case study was based on four steps: **1st step –** Identification of the main tourist attractions in each county; **2nd step –** Geographic representation of the main tourist attractions in each county; **3rd step –** Creation of a themed map with the main tourist attractions in each county; **4th step –** Creation of themed maps for photovoltaic and wind parks in the region of Algarve.

Case Study Selection.

1st step – Identification of the counties with great potential for conflict.

Firstly, the counties with high potential for conflict were identified. A county is considered to have a high potential for conflict if it meets the following criteria: a) possesses the 4 typologies of tourism (recreation, wellbeing, nature and cultural) and b) Has at least one wind park or a photovoltaic park.

Through the analysis of the touristic attractions and renewable energies themed maps, it was concluded that the counties of great conflict are: Alcoutim, Tavira, Albufeira, Portimão, Monchique, Lagos, Silves, Vila do Bispo and Aljezur.

2nd step – Additional criteria

Since the goal was to select only one county for the case study, two additional criteria were used, the first would preferably select counties with a balanced distribution of the various types of tourism where the landscape plays a relevant role. The second preferably selects counties which have already planned intentions of solar and wind energy exploration. According to these criteria, only the county of Monchique meets the requirements, and was therefore chosen to be the case study.

Structure of the Inquiry

The inquiry used in this work is composed of three distinct parts. The first part is taken up by eight questions of free open answer and closed answer in which personal information about the subject can be obtained (item 1 to 5) and their relation to the local (item 6 to 8). The second part consists of 15 remarks, formulated with the objective of measuring the environmental concerns of a group of individuals, to which the name NEP (New Environmental Paradigm) scale is given **(Anderson, 2012)**. The third and last part consists of two groups of respectively 4 and 8 closed answer questions and one open answer question, in which the goal is to understand the tourist perception relative to the landscape alterations caused by the introduction of wind turbines and photovoltaic panels and their opinions about the usefulness of this structures.

Data Collection

One hundred tourists were interviewed in Monchique county in diverse public and private spaces, namely on the central square of Caldas de Monchique, on the towns pool and central area of Monchique Village, and in “Villa Thermal das Caldas de Monchique Spa Resort”. The data collection was done in a period of two days during the month of July of 2015.

Data Treatment

The treatment of data was done through descriptive statistical analyses, making use of Microsoft Excel and SPSS Statistics. The answers to the open questions were categorized in a way so that all answers add a numerical meaning such that they could be processed with the same method. For analyses of relations between variables descriptive statistics were used, namely the commands “explore” and “cross reference

table" of SPSS and the inferential statistics (Qui-squared tests, T-student and Anova)

Results

Sample Characteristics

We verified that the individuals sample was made up of predominantly females, and the average age is 38 years old; the majority of the subjects have a graduate education; reside in urban areas; 10 different nationalities, mostly Portuguese, English, Dutch, Swiss and German. The Portuguese portion of the sample was mostly distributed between Algarve and Lisbon as well as Midwest.

Environmental Profile of the Respondent

It was found (figure 3) about the profiles of the respondents that most of them (71 respondents) belong to "highly environmental profile" and only two belong to the "reduced environmental profile". So it can be considered that, in general, the respondents tend to show a ecocentric behavior.

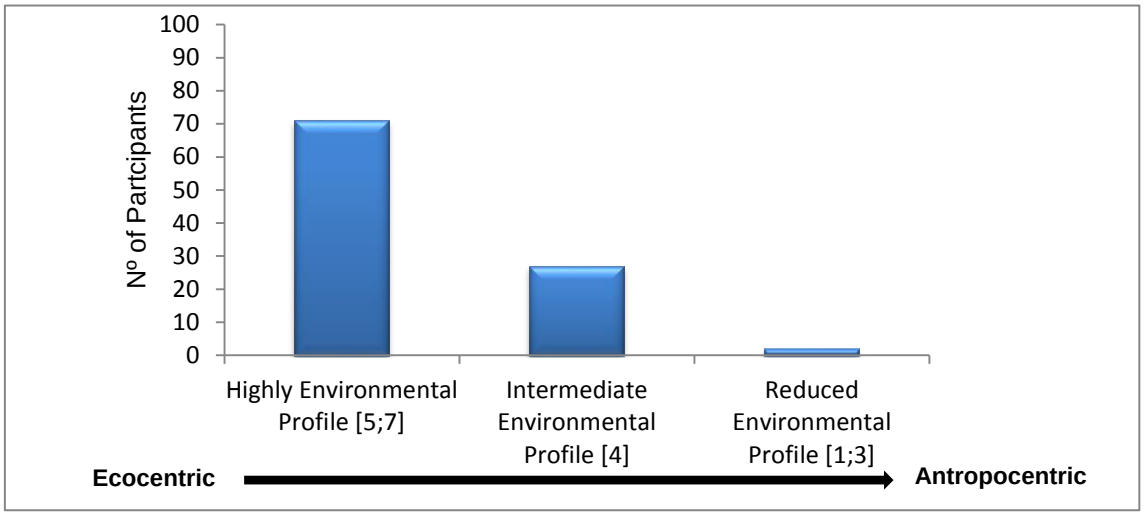

Figure 3: Environmental profile of the respondent.

Perception of the landscape

Firstly, we tried to understand the perception of the inquired subjects about the first set of images, which depict the original untainted landscapes (without the introduction of renewable energy infrastructure). Solely by analyzing the frequency distribution of the four original landscapes (**Figure 4**), it was found that landscape A shows the highest frequencies for the higher values (6 and 7), further more it is the only on which presents a null frequency for values bellow the midpoint (4). When we compare the remaining landscapes, it is verifiable that, after A, the highest frequency for the top value (7) is presented by landscape D, however when we analyze, for example, the second highest value, the same is not true. To be able to rate the landscapes from A to D only by the frequency distribution, it is necessary to do a sum of the number of individuals who had indicated values greater or equal to 4 and the number of individuals who decided to pick a value of 4 and lower and

compare both sums between themselves. By the average value it easy to come up with the preferential order: 1st- A; 2nd- D; 3rd- B; 4th- C.

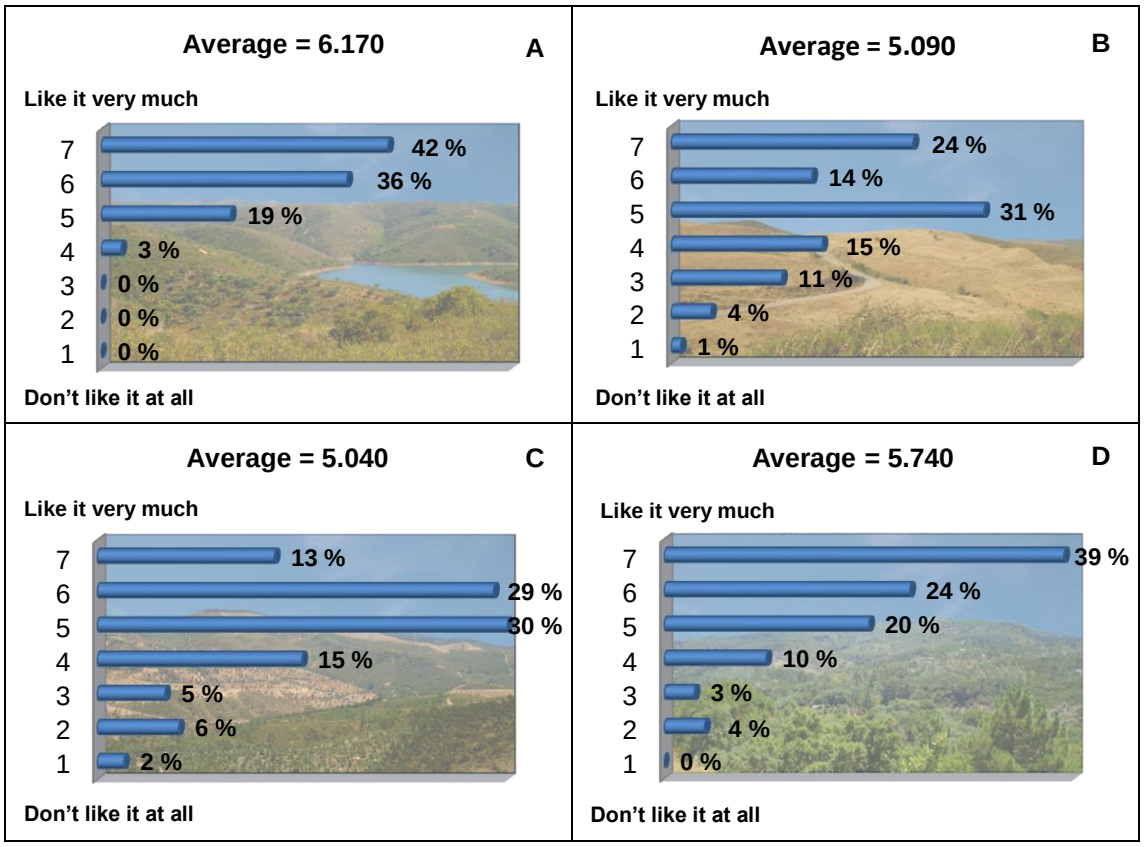

Figure 4: Distribution and average of answers for the first set of images (original landscapes).

The second set of images (**Figure 5**) corresponds to the simulated landscapes (with the presence of renewable energy infrastructures) with greater or lesser construction intensity. For each of the original images two different simulations were made, with a variable amount of structures.

Figure 5: Second set of images (simulated landscapes).

Through analyses of the average values for the relative preferences in the second set of images **(Table 1)**, relative to the simulated landscapes, it can be seen that the preference order of the inquired subject is as follows: 1st-G; 2nd-H; 3rd-E; 4th-A; 5th-B; 6th-F; 7th-C; 8th-D.

Table 1: Average values for the respondent preferences relative to the second set of images correspondent to simulated landscapes.

	A	B	C	D	E	F	G	H
Mean	4.180	4.060	3.790	3.600	4.240	3.810	4.400	4.360

So it can be concluded that people prefer wind turbines to photovoltaic panels, so much so that the data shows people prefer a landscape with high concentration of wind turbines to a landscape with low frequency of solar panels. This conclusion is easily explainable by the attribution of the last places in the scale to the images C and D.

By analyzing the average value of preference of the enquired relative to the transformations which occur in each of the original landscapes from A to D **(Table 2)**, it is found that for all landscapes the respondents had preference towards the original pictures (without introduction of renewable energy infrastructure) and amidst the simulated images (with introduction of renewable energy infrastructure), their preference always tends to be towards the images which show a smaller intensity of construction related to renewable energy infrastructure, either wind energy or solar power.

Table 2: Average value of preference relative to the transformations done to each of the landscapes.

	A_1	A_2	A_3	B_1	B_2	B_3	C_1	C_2	C_3	D_1	D_2	D_3
Mean	6.170	4.180	4.060	5.090	3.790	3.600	5.040	4.240	3.810	5.740	4.400	4.360

Index 1- Original Image; **Index 2**-Simulated image with low intensity of construction; **Index 3**- Simulated image with great intensity of construction.

Relations between variables

It might be relevant to analyze some relations between variables. From the obtained results it was found the following:

- The female gender presents a more ecocentric profile than the male gender;
- The individuals with lesser levels of education (basic education) are the ones who show a more ecocentric profile;

- Individuals living in urban areas, namely large cities (>10000 inhabitants), show a more ecocentric profile;
- The respondents with a more ecocentric profile are the ones more displeased with the introduction of renewable energy infrastructure into the landscape;
- The respondents with a more ecocentric profile are the ones who majorly answer in a negative way to questions about the usefulness of technical elements (wind generators and solar panels) in the landscape;
- Individuals living in urban areas, specifically from big cities, are the ones to show to be more displeased about the introduction of renewable energy infrastructures into the landscape;
- Individuals who have been to Monchique "many times" are the ones to be less displeased by the alterations to the landscape;
- Respondents who are more displeased about the introduction of infrastructures into the landscape are the ones to show more doubts about the usefulness of said infrastructure.

Result analyzes

The main conclusion about the tourist perception relative to the visual impact on the landscape caused by the introduction of renewable energy infrastructure (wind turbines and photovoltaic panels) is: 1) it depends on the type of infrastructure; 2) it depends on the intensity of infrastructures placement; and 3) depends on the tourist's profile.

The tourist's perception depends on the type of infrastructure introduced into the landscape (wind turbines or solar panels), and certainly on the typology of the projects and the way they can be integrated into the landscape. The intensity of placement of renewable energy infrastructures is an issue that also influences the perception of tourists, it was found that for both types of technical elements (wind turbines and photovoltaic panels), they always prefer the landscapes with less intensity.

The results also lead to other interesting questions, namely, what does being ecocentric entail. It wouldn't be strange if the environmental paradigm itself was changing. Initially it may have been associated with the higher tiers of education in society and mayhap with greater access to information; nowadays, it seems that at least environmental attitudes (even if with no correlation with behaviors) permeate, in one way or another, the whole of society: having environmental concerns now grants a high social status while at the same time makes it easier to fit in society. *"In Europe it is far easier to channel your good intentions into action. And you feel far worse if you don't. If nearly everyone is carrying a plastic bag (as in New York City) you don't feel so bad. But if no one does (as in Dublin) you feel pretty irresponsible"* **(Rosenthal, 2009)**. So it isn't surprising that the more ecocentric respondents featured in this work aren't necessarily the more educated ones.

Furthermore, about environmental profiles, the fact that the individuals with a higher ecocentric profile show to be more

displeased with the introduction of energy infrastructure into the landscape is a remarkable finding. Back to the theme of range of the meaning of ecocentrism, it is pertinent to remember that the NEP scale focusses on five hypothetical facets of a single vision of an ecologic world. The first facet deals with the reality of growth limits. The "peak-oil" theory is likely one of the main limiting factors for growth, and its consequent climatic changes. The third tackles the fragility of nature's balance which in this case might be expressed as the quality of the landscape when renewable energy infrastructure is implemented into it. Therefore, here is the "dilemma" placed on the ecocentric tourists to decide what do they value more. Being tourists who had to make a trip to experience these landscapes, it's to be expected that the landscape might have a higher value than the energetic resource, making It close to what is referred in the literature as "NIMBY". In this case the "backyard" is the tourist destination which was "paid" to be used and is therefore "mine" even if only temporarily **(Delicado et al., 2014 & Van der Horst, 2007).**

These results end up only being an example of the complexity in understanding what the environmental paradigm is today and its potential conflicts between multiple environmental dimensions, which might upset each other, as to create dilemmas of choice. In **Delicado et al., (2014)** the "dilemma" is related to the incompatibility between the generalized support for renewable energies at the same time as a local opposition to the localization of the infrastructure. This dilemma is evident in this study, in which we find that in general the sample of respondents with a more ecocentric profile end up not being pleased with the introduction of technical elements into the landscape, saying that this kind of infrastructure should not be introduced into the landscape because they impact it in a negative way. "*In the case of wind power there are strong 'green' arguments on both sides of the debate. Some environmentalists advocate windfarms because of their 'clean energy' credentials, while others oppose them because of their landscape impacts. Still others are caught awkwardly in the middle, supporting renewable energy in principle but opposing specific windfarm proposals"* **(Warren et al., 2005, pp. 854)**.

Conclusion

The motivation for the realization of this work came with the knowledge of the lack of participation of the public in the process of planning of the installation of renewable energy projects, namely wind parks and photovoltaic plants, as well as the tiny existence of this type of methodic approach in studies performed in Portugal. It was found that the documents resulting from this type of approach (SEI or SEInc), in respect to the visual impact of introducing this type of infrastructure still had an expert view to them, lacking a public opinion.

The goals imposed by the European Union about the production of energy from renewable sources led all of Europe and particularly Portugal to a gradual and inevitable implementation of infrastructure for renewable energy production. To this, it

needs to be added the necessity of physical space, which in turn means a dependence on the biophysical aspects of the landscape (soil). This leads to a conflict of intentions about the soil, on one side the agents responsible for renewable energy project, on the other tourist entities who need physical space for their infrastructure. Tourism more than depending on the landscape for its soil also depends on its aesthetic qualities. So, it's apparent that a relation in the concepts of "energy-landscape-tourism" exists and cannot be ignored. It was with this in mind that we considered important to study the perception of tourist relative to the impact on the landscape quality caused by the introduction of renewable energy infrastructure (wind farms and photovoltaic power plants).

We hope that this study can help to improve the understanding of the relation "energy-landscape-tourism" and to create the necessary conditions so that this conflict can be managed in a more informed manner. We also expect this study to be a first push for the development of further research on this topic. It would be interesting to, in a future work, analyze different groups of the public (residents, tourists, county officials, local commerce, etc.) and perform a comparative analysis.

This work focuses essentially on natural landscapes, however, it would be pertinent to apply the same methods to a greater diversity of landscapes, such as the ones in the Algarve coast, which has different dynamics to the ones presented here in regard to the visual quality and intensity of tourism.

Finally, we found that the methods used in this study could be explored at a research level in order to identify what can be considered the "acceptable limits of transformation to a landscape". This information could then later be applied in the planning and impact assessment of renewable energy projects, particularly in regions where tourism has a high economic importance.

Another proposal for future developments, would be the application of multivariate statistical analysis to the data processing, in particular the application of principal component analysis.

Finally, it is also relevant to highlight some of the limitations of this work. The first relates to the subjectivity adjacent to the preparation of the photographic simulations. In this work, there was talk earlier of subjectivity associated with the process of evaluation of landscape quality, however this subjectivity is also present in the preparation of photographic simulations. If selected landscapes, or the disposition of wind energy infrastructure and solar energy have been other, probably the results could have been something different. The second limitation is related to weather conditions that are responsible for the light conditions and that can affect the preferences of a person in a given landscape.

References

Anderson, M. (2012). *"New Ecological Paradigm (NEP) Scale",* Disponível em http://www.berkshirepublishing.com/. Acesso a 10 de Julho de 2015.

CCDR Algarve (2013). "*Algarve - Preparar o Futuro*", Diagnóstico Prospectivo 2014-2020, Versão Aprovada pela Conselho Regional a 22 de Março de 2013, Praça da Liberdade, Faro, Portugal, pp. 1-32.

Cruz, A. (2010). *"Turismo e Criatividade no Algarve: Uma análise da oferta túrística Regional como Elemento de Atracção da Classe Criativa",* Tese de Mestrado em Gestão e Desenvolvimento de Destinos Turísticos, Universidade do Algarve, Faculdade de Economia da Universidade do Algarve, pp. 1-125.

Delicado, A., Junqueira, L., Fonseca, S., Truninger, M., Silva, L., Horta, A & Figueiredo, E. (2014). *"Not in Anyone's Backyard? Civil Society Attitudes towards Wind Power at the National and Local Levels in Portugal",* In Science & Techonology Studies, Vol. 27, Nº 2, pp. 49-71.

Delicado, A., Silva, L., Junqueira, L., Horta, A., Susana, F & Truninger, M. (2013). **"***Ambiente, paisagem, património e economia: Os conflitos em torno de parques eólicos em Portugal",* Revista Crítica de Ciências Sociais, 100, pp. 11–36.

Eurostat (2011). *"Energy, Transport and Environment Indicators 2011",* Luxembourg: Publications Office of the European Union, pp. 3-247.

Gonçalves, A (2014). *"Algarve- Regional Energy Profile",* MED Programme, version 0.1, pp. 3-27.

Häyhä, T., Franzese, P & Ulgiati, S. (2010). *"Reducing the use of fossil fuels: Scenarios for Finland's energy future",* pp. 1-10.

Kienast, F., Morán, L & Hersperger, A. (2012). *"Conflits between the production of renewable energie and other landscape services in Switzerland (Final Report)",* Swiss Federal Institute for Forest, Snow and Landscape Research, pp. 5-60.

Nadaï, A & Van der Horst, D. (2010). *" Landscapes of Energies "*, In Landscape Research, Volume 2, pp. 1-11.

PNAER (2010). *"Plano Nacional de Acção para as Energias Renováveis ao Abrigo da Directiva 2009/28/CE",* Versão Final, pp. 2-128.

Puiu , V., Zotic, V & Alexandru, D. (1974). "*Tourism Development and Geographic Landscapes. Case Study: Azuga Town"*, Faculty of Geography, Babes-Bolyai University, Romania, pp. 286-291.

Rosenthal, E. (2009). *"What Makes Europe Greener than the U.S?",* Disponível em http://e360.yale.edu/feature/what_makes_europe_greener_than_the_us/2193/. Acesso em 27 de Outubro de 2015.

Van der Horst, D. (2007). *"NIMBY or not? Exploring the relevance of location and the politics of voiced opinions in renewable energy siting controversies,* In Energy Policy, Vol. 35, pp. 2705-2714.

Warren, C., Lumsden, C., 0´Dowd, S & Birnie, R. (2005). *" ´Green on Green´: Public perceptions of wind power in Scotland and Ireland"* In Journal of Environmental Planning and Management, Vol. 48, Nº 6, pp. 853-875.