Community perceptions of renewable energies in Portugal: impacts on environment, landscape and local development

Ana Delicado, Elisabete Figueiredo, and Luis Silva
Institute of Social Sciences of the University of Lisbon, Portugal
University of Aveiro, Portugal
Centre for Research in Anthropology (CRIA/FCSH-UNL), Portugal

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Abstract
This article aims to contribute to the debate on energy transitions in Europe, by focusing on community perceptions in a southern European country marked by a significant development of renewable energy in recent years, Portugal. Three main dimensions of community perceptions of the impact, both positive and negative, of renewables are addressed: environmental, landscape and socioeconomic. The article is based on case studies of communities living in the vicinities of three wind farms and a solar power plant. The results show that, in order to better understand the factors for social acceptance, not only community perceptions are heterogeneous but also that is crucial to examine them not just at the planning stage but also once the energy infrastructures are constructed and functioning.

Keywords
Wind energy; Solar energy; Environmental impact; Socioeconomic impact;

1. Introduction
Most of the social sciences literature on renewable energy and communities is still very much focused on the factors of acceptance and resistance and on participation and engagement during the planning stages. Far fewer articles address what happens in communities once wind farms, solar power plants and other energy infrastructures are built and start operating. Although several studies mention that social acceptance tends to grow after construction [1 - 4], few explore this change in detail and fewer still delve on the impact of renewable energy infrastructures in local communities.

Understanding how communities living in close proximity to these structures envisage renewable energy, its benefits and drawbacks, can generate relevant input for adjusting planning procedures, devising incentive schemes, avoiding negative impacts, ensuring environmental and social justice. And, since the most favourable locations are in many countries just about exhausted, especially in the case of wind farms, further development will require the siting of facilities in areas where they will have a higher impact, thus resistance is expected to grow.

This article aims to address that knowledge gap, by exploring the perceptions of communities living in the vicinity of wind farms and solar power plants, namely, the social and economic advantages and disadvantages, the environmental and health risks, the transformations in landscape and land use, the impact on local development,
highlighting the tensions and conflicts, as well as the negotiations and compromises achieved between local stakeholders. Three main dimensions will be explored: environmental and health effects, landscape and place attachment, and socioeconomic impacts.

The article is based on three case studies of wind farms and a solar power plant in Portugal. Renewable energy infrastructures have become a dominant feature in most of the rural landscape in this country: with close to 250 wind farms (totalling over 2,500 turbines), a third of the municipalities have at least one within their territory; this figure rises to close to half in the hilly northern and central regions (but increasingly reaching the southern areas as well) [5]. Therefore, many villages and small cities are directly affected, even if only in visual terms, by wind energy production. Photovoltaic solar power plants are less numerous (only 44 above 250 kW) and mainly located in municipalities in the south of the country [5].

We have argued elsewhere [6] that Portugal (and Spain) shows a distinctive pattern from northern Europe in terms of the factors for success in energy transition. The growth in renewable energy has been the result of very favourable policies (based on feed-in tariffs and public tenders for renewable energy connections to the grid) that have spurred the interest of large electric companies, whereas other factors considered relevant in other countries, notably community participation in decision-making and even ownership of infrastructures, are entirely absent. Direct benefits for municipal authorities (2.5% of the annual revenue of wind farms) and centralised planning practices have led to fairly low levels of controversy and a very high rate of project approval. Thus, perceptions of communities in Portugal may differ from their counterparts’ in Europe and other places, but we will endeavour throughout the article to draw comparisons with international literature whenever possible.

2. Framework
Community responses to renewable energy facilities have been relatively well studied within the social sciences over recent years, particularly regarding the factors and processes underlying local acceptance and/or opposition, as well as the main impacts and benefits for local communities [3, 7 - 12]. However, the great majority of studies focuses on responses before construction and not after the facilities have been running for a few years, when the impacts, positive and negative, become more visible and local expectations are met or not.

Within this literature, the most frequently studied issues concern the relationship between social perceptions of impacts and the degree of acceptance from local stakeholders [3, 10 - 12], as well as the perceptions of negative environmental, landscape and tourism impacts [6, 13 - 16]. In what regards solar energy, studies also cover issues related to space organization [17] and the occupation of agricultural land by large solar power plants [18 - 20].

Environmental impacts tend to dominate expert debates around the siting of energy facilities [15, 21 - 23]. The mortality rates of birds, bats, and other wildlife due to the construction and operation of wind farms and solar power plants is a major concern for environmental organisations and a justification often mobilized for rejecting planning applications or setting up mitigation measures. Conversely, renewable energies play a crucial role in preventing climate change, a fundamental goal for most ENGOs, which
leads to what has been called ‘green on green’ controversies [2, 24 - 25]. However, there are few studies on how local communities envisage these environmental considerations and whether they play a role in promoting the acceptance/rejection of renewable energy infrastructures [26 - 27].

Health concerns are another frequent topic in the literature concerning the acceptance of renewable energy facilities. Noise and vibration from turbines and electromagnetic radiation from high voltage power lines are feared to cause health risks, a common complaint expressed by local communities when faced with wind farm projects in several countries [4, 28 - 32]. There is an abundance of references in the literature (e.g. volume 31, issue 4 and 5 of the journal *Bulletin of Science, Technology and Society*) showing that this matter is far from settled and scientific controversy remains.

Commonly defined in the scholarly literature as a twofold phenomenon, including both, and simultaneously, a territory and an image [33 - 34], landscape is also a core topic in the public debate about energy transition worldwide (e.g. [2, 35]). Nowadays, though this is not always the case (e.g. [36]), there is a widespread opinion that renewable energy generation technologies in general and wind developments in particular stand in conflict with landscape preservation and values (e.g. [37]), particularly in rural areas (e.g. [24, 38 - 39]).

Some studies (again, mostly based on research carried out before the construction of infrastructures) highlight the role of place attachment in the acceptance of wind and solar farms [7, 40 - 41]. Symbolic contradictions between nature and industry, perceived threats to collective identity, emotional connections to a particular location or scenic feature are put forward as factors for rejecting the construction of these facilities. However, as Carlisle *et al.* [7] have ascertained, they can also work as factors for support, when coupled with perceived economic benefits.

Despite the fact that the majority of wind farms and solar power plants are located in disadvantaged rural areas, little empirical evidence and theoretical reflection have been produced regarding the link between renewable energies and local development. Recent studies, however, emphasise the need to assess these articulations at the local level [8, 11, 42 - 43]. According to Kitchen and Marsden [44], renewable energies have the potential to foster eco-economies in rural territories, that is, to re-embed the social and economic fabric of rural areas in ‘clean’ and locally available natural resources which may lead to a more sustainable and sustained development, replacing or reconfiguring current generally fragile and subsidized agricultural systems [43].

Having in mind the diversity of rural areas as well as their diverse capabilities in terms of negotiation in the renewable energy production sphere, some benefits and positive impacts on local communities’ development are generally pointed out [8, 11, 29, 42, 43, 45]. According to Munday *et al.* [43], these benefits and positive impacts can be divided in four main categories: conventional economic benefits (use of local labour force and local enterprises, land rental); economic flows and benefits to local communities (ownership of facilities by residents, community funds, cheaper electricity, and sponsorship of local events); contributions in kind to local assets and facilities; and provision of other local services such as the support to educational visits and programmes.
Some of these benefits and positive inputs to rural development may be compromised by the fact that, as it is the case of the wind energy production in Portugal, promoters are generally large national and international enterprises [45]. In these cases, local direct impacts are generally scarce and additional efforts are needed in order to find alternative ways of benefiting local communities and fostering local development [11, 42 - 44].

The generation of local employment opportunities deriving from the exploitation of renewable energies is one of the most valued aspects by local populations [42]. In fact, in social and economic depressed and declining areas, with scarce job opportunities, the generation of local employment – even if in a reduced number – may have a positive impact in terms of retaining population and improving living standards. According to the abovementioned authors [42], wind energy generally creates more job opportunities for local inhabitants, even if they are often temporary. At the same time, besides the quantitative dimensions of job creation, one must consider the symbolic dimensions in terms of local social cohesion and increase of self-esteem among rural residents.

Other aspects such as the opportunity to diversify local economies and productive systems, as well as the articulation with other activities (e.g. tourism, educational projects and agriculture), are also relevant to foster local sustainable development processes. Although still relatively scarce, especially in relation to southern European countries, research into the relationship between energy landscapes and tourism has shown conflicting results: energy technologies, particularly wind farms, may have positive effects on tourism in some coastal and rural areas, functioning as tourist attractions per se and, thereby, contributing to the development of new forms of tourism (e.g. [46 - 48]); but they may also jeopardize the appreciation and preservation of landscape and heritage (cultural, historical, natural, archaeological) and, hence, the actual or potential tourist demand for the affected area (e.g. [13, 38, 41]).

The contribution of renewables to local sustainability may lead to the emergence of general social benefits [42 - 44], although Brown [11] and del Río and Burguillo [42] present some empirical evidence regarding local social perceptions of the distribution of benefits as unbalanced and uneven. In the same vein, other authors [8, 9, 43] use the concept of ‘distributive justice’ as one of the key aspects in residents’ perceptions and acceptance of wind farms and solar power plants. In addition, it is possible to point out a mismatch between the expectations of local communities regarding economic and social benefits and the real positive impacts deriving from renewable energies exploitation [11, 17, 43]. If, on the one hand, the dominant political discourse on renewable energies’ benefits tends to emphasise the economic impact on local communities, on the other hand, local populations tend to consider that their expectations are not generally met.

3. Methods
Data for this article stems from four case studies conducted in localities in the vicinity of renewable energy facilities in Portugal: three wind farms and one photovoltaic solar power plant. The wind farms were selected among the existing 245 through a set of criteria: location (in different areas of the country), year of construction, size (number of turbines) and the participation of citizens and local stakeholders in the public consultation in the Environmental Impact Assessment (EIA) process, with both opposing and favourable statements (taken as an indicator of potential controversy). The solar power plant was a more ‘obvious’ choice: it is the largest in the country, the only one above 15 MW.
In all case studies, similar procedures were followed. First, a comprehensive collection of documents pertaining to the case was conducted: EIA and public consultation reports, statistical data concerning the municipalities, news articles in national media, leaflets, websites and blogs. The document analysis allowed reconstituting the story of each wind and solar farm and identifying the main stakeholders: current and former holders of municipal and parish roles, local associations, newspaper editors, business owners, and developers. Fieldwork at the site was then carried out: project researchers spent a few weeks in each location, interviewing stakeholders (on average 15 in each case), conducting further document collection and analysis (namely, articles in local press and minutes of municipal meetings at the local archives), and ethnographic observation. Finally, a series of interviews with residents were conducted. An initial attempt to follow systematic procedures of door-to-door interviews failed, since in rural areas residents proved to be reluctant to talk to strangers in their homes. The researchers then opted to approach residents in public places: supermarkets, cafes, parks, market squares.

In each location, around 25 interviews with residents were conducted, balanced in terms of gender, age groups and place of residence (in the main town and in villages closer to the energy facilities). On the whole, 150 interviews were carried out, taped, fully transcribed and subjected to a content analysis with QDA software (MAXQDA$^{10}$). The content analysis grid was built based on the literature review and document analysis, and had two levels. The first level had 11 themes: general opinions on the wind farm/solar power plant, preparatory studies, public consultation, construction stage, role of the local authorities, use of the municipal income from the wind farm/solar power plant, perceived benefits, perceived disadvantages, controversy, impacts, perceptions of energy. Sentences could be coded in more than one first level theme. We have chosen not to present quantitative results of this analysis because our aim is to show the range of different opinions and because we cannot guarantee the representativeness of the sample of residents.

3.1 Case study locations
The wind farm of Alvaízere (WFA) is located in the west coast of (mainland) Portugal, 167 km north of Lisbon, and it has nine wind turbines, with an installed capacity of 18 MW. Alvaízere is a small municipality, with 7,287 inhabitants. The wind farm is located in a protected area (Natura 2000 network, Habitats Directive 92/43/CEE) that was considered the most significant landmark of the region, the mountain of Alvaízere. It was subjected to an EIA in 2004 that received unfavourable comments from Environmental NGOs, due to environmental (bat populations, rock formations) and heritage (archaeological remains) concerns. The wind farm started operating in 2010 and is owned by Endesa, a Spanish electricity company (the second largest operator in the Portuguese market). Since it is sited in vacant lands, rents are paid by the promoter to the municipality.

The wind farm of Serra da Freita (WFSF) is located in the central region of the country, in the municipality of Arouca (60 km south of Oporto), and it has 18 turbines, with an installed capacity of 37 MW. In 2011, Arouca had 22,359 inhabitants. The wind farm is located in a protected area (Natura 2000) with rare endemic species and wolf populations. The EIA was conducted in 2002 and the public consultation received unfavourable comments from local associations and citizens (claiming landscape and...
environmental impacts), and favourable ones from local authorities and a local business association. The wind farm started operating in 2006. It is divided in two wind farms, owned by different companies, one of which is the largest company in the renewable energy sector in Portugal. It is located in vacant land managed by the parish authorities, which receive rent from the promoters.

The wind farm of Terras Altes de Fafe (WFTAF) is located in the north of Portugal, close to the border with Spain. It is the largest and oldest of the three: it has 53 turbines (with an installed capacity of 106 MW) and started operating in 2004. Fafe is a municipality in the region of Braga with 50,630 inhabitants. The wind farm is located in several rural parishes, approximately 15 km from the city of Fafe. The EIA received favourable comments from some of the local authorities (focused on economic benefits) and unfavourable ones from some of the parish authorities and citizens (concerned with landscape impacts, noise and water contamination). The wind farm is owned by a French electricity company. The land where the wind farm is sited is privately owned by several small holders, who receive rent from the promoter. The wind farm is surrounded by a 14 km-long footpath, with information about natural and cultural heritage as well as renewable energy, which was built in cooperation between the developer and a local association.

The solar power plant of Amareleja (SPPA) is situated in the south of Portugal, close to the border with Spain, in the municipality of Moura. It has 2,520 solar trackers and an installed capacity of 45.8 MW, occupying an area of 250 ha. It is right next to the village of Amareleja, which has 2,500 inhabitants. The solar power plant started functioning in 2008 and no EIA was conducted, although local debates about it were organised. The initial proposal was developed by the municipal authority and a small company, but they were forced to sell the project to a large Spanish company, receiving a compensation of €2 M, which was diverted to a social fund that funded several projects, such as the creation of a technological park and an incentives scheme for domestic generation of solar power. The parish of Amareleja owns the land and receives the rents.

Figure 1. Location of the case studies in Portugal
4. Results

The case studies allowed us to delve into the perceptions and representations of local stakeholders and residents concerning renewable energies and, in particular, the wind farms and solar power plant sited close to their locality. These perceptions and representations are crucial to understand the degree of acceptance of renewable power, the diverging interests within communities, and the tensions and conflicts that have arisen (or might arise in future).

Although we cannot quite match the fine distinctions that Le Floch [49] established between the ‘resident’, the ‘inhabitant’ and the ‘citizen’, some differences can be found in the discourses of stakeholders and residents that we will seek to highlight. Most stakeholders are somehow involved in the processes of setting up the energy facilities and this, of course, colours their opinions. Local authorities, in most cases, are direct beneficiaries and have had a crucial role in allowing renewables into their territory. Local associations, especially those dedicated to environment or heritage, often opposed the construction, to little avail. Local businesses can be impacted both positively and negatively by wind farms and solar power plants, since they can either bring development and employment or threaten tourism and pre-existing activities. Conversely, residents often express no opinion about renewables. A number of interviews go little beyond answers such as ‘I don’t know’, ‘I don’t much care’, ‘I don’t have an opinion’, ‘I know nothing about these things’.

4.1 Environmental and health effects

Although, as shall be seen directly below in this article, environmental concerns are a fairly common motive for opposing renewable energy, many stakeholders and residents also strongly acknowledge their environmental benefits. Indeed, interviews are rife with
comments supporting renewable energies by characterising them as ‘clean’, ‘pure’, ‘non-polluting’, ‘green’, ‘more right’, ‘good’. See, for example, these two statements:

If we can have wind energy, pure energy, why should we put energies that pollute nature?! (interview WFA resident #20)

The fundamental about wind farms is that they don’t pollute. They are not polluting, they are not destroying nature; they are doing absolutely nothing, so I think wind farms are very positive. Besides the tiny visual impact. (interview WFSF president of the parish council #2)

In this regard, many interviewees highlight the strong connection between renewable energies and nature:

To take advantage of what nature gives us, namely, Alviázar and the whole country, we are positively showered with what nature gives us, which is wind and sun. (Interview WFA president of the parish council #1)

Another frequent representation focuses on the endogenous character of renewable energies, by making use of local resources. This type of statement is quite common in all case studies, but particularly so in the solar power plant, mostly because the publicity at the time of its construction often emphasized how Moura and Amareleja were the sunniest places in the country (with the highest number of sun hours per year). The local community have appropriated this trope and now reproduce it in their discourses:

Our municipality, for the best part of the year, is the hottest in the country. Since we have these natural resources, we should take advantage of them. The land is also favourable, it’s flat, whereas in the north it is all up and down and they don’t have as many hours of sun. If we make that comparison, Alentejo can have as many as a few hundred hours of sun more than the north. (Interview SPPA resident in Moura #3)

Less common but not entirely absent in local representations (of stakeholders rather than of residents) is the positively valued notion that renewable energies are contributing to the solution of global environmental problems at the local level:

The first benefit we will see from wind farms is that this type of energy is very important, for human life is very important. […] I know that, at a global level, it brings us many and large benefits. (Interview WFTAF president of the parish council #5)

Several interviewees (again, mostly stakeholders) also made comparisons between renewable energy and other types of energy in terms of environmental impacts. Wind farms and solar power plants are seen as much less damaging than fossil fuel or nuclear energy, but also other kinds of renewable facilities, such as hydroelectric dams and biomass plants:

I think that we should seek, through all means, to use renewable energies in order to avoid fossil energies, derived from fossil fuels, and mainly nuclear energy. All that would be very bad for all of us. (Interview WFSF former mayor)
Hydropower is a sort of renewable energy that has much more environmental impacts, not just over landscape, but also over sand depletion in beaches downstream from dams, in beaches by the river but also by the sea. So I think that wind energy has more advantages. (Interview WFTAF association #4)

We know that the impact of wind energy is reduced, when compared with a biomass processing plant that would burn industrial waste, isn’t it?! (Interview WFSF former municipal councillor #1)

However, opposite opinions regarding environmental impacts can also be found and are far from uncommon. In fact, residents tend to either mention general environmental effects or, in fewer cases, to echo the concerns of ENGOs regarding particular wildlife species, especially when these have been heavily discussed in the EIA stages or during construction, as in the case of the wind farm of Alvaízere:

I don’t think that they [wind farms] should exist, because I’m against destroying the environment. (Interview WFA resident #34)

All that messes with nature harms it and it seems that over there, the bats, they were affected for sure, because that changes completely. (Interview WFA resident #6)

Some residents also express concerns based on a lack of knowledge and assurance of environmental harmlessness, in a sort of ‘lay’ precautionary principle:

I don’t know what guarantees it [wind farm] gives and the ones it doesn’t. Some people, like me, have beehives, some say it destroys bees, it kills them. So, does it or doesn’t it?! (Interview WFSF resident #10)

Others still develop their own ‘lay theories’ about nefarious environmental impacts of energy infrastructures:

It's negative because it [solar power plant] creates a greenhouse effect. In my modest opinion, sun rays are projected back into the air and it creates a mini-greenhouse effect in that area. (Interview SPPA resident Moura #9)

Local stakeholders, particularly those who have a critical view of wind farms and solar power plants (often associations devoted to environment or heritage), raise a different type of issue, more grounded in scientific information about impacts, notably the problems of waste and obsolescence of materials:

That glass [in solar panels] is not reusable, it has silicon components; […] that fibre [of the wind turbines], when it breaks, I don’t know how they repair it […] so how are we going to treat this waste? We are now concerned with car waste, domestic waste, electronic waste, industrial waste, chemicals and all that. I don’t think that we have gone round to the idea of how we are going to treat a solar panel. (Interview WFA association #2)

I think that there won’t be enough money for the upkeep of wind farms. They are going to start falling one by one, things and going to stay up there, no one will
remove them, it’s going to be very expensive, no one will want to shoulder that cost and we know how justice works in Portugal, no one is going to get penalised for it. (Interview WFSF former city councillor #2)

Regarding the noise complaints and health concerns that feature so frequently in the literature on this subject, our case studies show that community perceptions of renewables do encompass this subject. We have found evidence of noise complaints in several interviews, particularly with residents that live closer to the wind farms:

There is a noise that sounds like an airplane about to fall. My feeling is that it’s an airplane that is passing by and is falling. Sometimes is more noticeable than others. [...] I personally notice that while there is this ‘zuumm’ there is no noise from the birds. We used to have it but now we don’t anymore. (Interview WFA resident #1)

I have double glazing at home and I can hear the noise, even with the windows closed, when the wind is strong. You would have to be deaf not to hear it. (Interview WFSF resident #4)

Health concerns are very scarce, though one of the interviewees mention a fear of unknown risks, coupled with a mistrust in expertise:

I’m not much informed about this thing [solar power plant]. I don’t know if it’s good or bad for you. There are so many things that used to be bad and now they say it’s good. Who knows if tomorrow someone says that it’s bad for your health? I don’t know. (Interview SPPA resident Moura #5)

4.2 Landscape and place attachment

Research inside and outside Europe has shown that the detrimental effect of renewable energy generation technologies on heritage (e.g. [39]) and, above all, on landscape is frequently mentioned as a negative outcome of energy transition, particularly in the case of wind farms and solar power plants, and most especially in the countryside, as noted above in this article. The four cases under study in this project are no exception.

In fact, to some respondents, the construction of the wind farms has had a negative impact on heritage, mainly on natural and archaeological heritage. This, for example, is the case of two associations, according to whom the wind farm has ‘changed the natural heritage’ in Terras Altes de Fafe (interview WFTAF association #1) and some ‘primitive structures’ in Serra da Freita, including ‘a set of carved stones’ (interview WFSF association #2). Equally, another interviewee has stated that it has ‘spoiled the mountain of Alvaiaízere as heritage’ and entailed the ‘destruction of some thousands of square meters of grikes that allegedly were a protected value of Natura 2000 and two caves’ (interview WFA resident #20).

In turn, the construction of the solar power plant has been criticized by several residents in Amareleja, on the grounds that it involved the destruction of an airfield that they considered as an integral part of collective heritage, ‘an old thing that belonged to the people’ (interview SPPA resident Amareleja #2). However, the mayor of Moura and a representative of the promoter of the project (Amper Solar) commented that the restoration of heritage items – ‘a derelict house that was the house of the guard and a few wells’ – constituted one of its benefits.
Meanwhile, in the localities studied here, energy technologies are mainly criticized due to the negative effect that they are considered to exert on the landscape chosen for their siting, most especially in aesthetic/visual terms. Actually, in all cases, there are respondents to whom the wind farms have brought negative ‘landscape transformations’; they ‘spoiled the landscape’ and ‘the view of the mountain’; they ‘tainted what was a nature mountain’; and they ‘have a visual impact that displeases at 100%’. In the case of Amareleja, similarly, there is a general opinion that the solar power plant ‘is completely out of place in the landscape’ and that it ‘spoils a little the landscape’.

Underpinning this negative perception of the energy landscape relationship is the identification of energy technologies as manufactured, or, to introduce a recurring term in the interviewees’ discourses, ‘artificial’. The statements that follow exemplify this point:

If now appear wind turbines instead of trees […], it will not attract tourists, people are not feeling well, the birds also will not be around, there will be a number of negative impacts that are not sustainable in our community. (Interview WFSF association # 3)

There is something that was put there by man and does not necessarily has to do with nature. (Interview WFSF former municipal councillor #1)

On the aesthetic point of view, regardless of their usefulness, I do not like to see, in my mountainside, these eyesores. We like to see raw nature. (Interview WFA resident #6)

On certain cases, energy landscapes also provide space for a comparison between modern energy technologies and traditional ones, notably wind turbines and windmills:

The first engineer who arrived there, I asked him about the viability of the project in our parish and he looked at me and replied, ‘Look, whoever has made that windmill, a hundred years ago, saw that the wind goes through there; I have no doubt that we will succeed there, as it is a windy place. (Interview WFTAF president of the parish council #3)

Sometimes, but only in the case of Terras Altas de Fafe, the disturbance of the landscape is also attributed to the accesses and the construction stage of the wind farm, on the grounds that it has ‘changed the structure of the mountain’ (interview WFTAF president of the parish council #5) and ‘involved the construction of roads – highways, I should say – to access the wind turbines for maintenance purposes’ (interview WFTAF association #1). In the case of Serra da Freita, a former member of the municipal government of Arouca also ascribed the negative landscape effect of the wind farm to the aerial power lines built to connect it to the electricity grid.

In addition, regarding ‘place attachment’, there are cases where the conflict between these technologies and the landscape results from the change of sites or spatial elements included in the affections and in both individual and collective memory. This is clearly expressed by three interviewees: ‘old people often refer to this part of the mountain with […] some memory of past times with their parents and grandparents who frequently went
to the mountains for sheep grazing [...] and olive tree cultivation’ (interview WFA president of the parish council #1); ‘I am absolutely against the implementation of the wind farm on the top of the mountain, because I am attached to that place; it is a place that I love’ (interview WFTAF citizen #1); and ‘there is a love of the place’ (interview SPPA resident Amareleja #7).

However, and illustrative of the subjective quality of these type of assessments, in all cases, there are respondents (though mainly stakeholders with a direct interest on the energy infrastructure) to whom the wind farm ‘does not affect’ the landscape; ‘it sits well on the mountain’; ‘it has a positive impact’; ‘it looks good’; ‘it is funny’; and ‘it fits well in the landscape’. In a similar vein, other respondents are of the opinion that the solar power plant of Amareleja ‘is perfectly integrated’ in the landscape (interview SPPA mayor of Moura), that ‘the impact it has in visual terms is virtually zero’ (interview SPPA resident Moura #3), that it ‘does not bother anyone’ (interview SPPA resident Amareleja #2), and that it ‘has a good framework’, with ‘the lake, the brightness of the panels making a mirror on the lake’, ‘sheep’, ‘trees’, and ‘the buildings inspired in the regional architecture of Alentejo’ (interview SPPA promoter from Amper Solar).

Moreover, evidence suggests that the landscape change is interiorized by many residents after the construction stage, as the statements that follow exemplify: ‘people are already accustomed to the wind farm; ‘it is already part of the landscape’; ‘all that we - humans - do has an impact; if we get used to it, after a few years, [...] it is an assimilated image’; ‘at the beginning, these thing have some impact, but a person ends up getting used to it’. 

4.3 Socioeconomic impacts
All the four cases in our study are located in rural areas that may be qualified as remote and peripheral, with long lasting socio-demographic and economic constraints and in which agricultural activities had lost their social and economic relevance. All the areas may be considered economically depressed and in need of alternative strategies for local development. These wind farms and solar power plants are owned by large companies, as is the case of the vast majority of similar facilities in Portugal, where 70% of developers’ market share in wind energy is held by only six companies, among which the incumbent electricity company EDP [50], unlike the predominance of community schemes or cooperatives that occurs in Denmark, Germany and Austria [2, 51 - 53]. Community ownership is considered a favourable factor for the local acceptance of renewable energy facilities [3, 52, 54], but the case of Portugal (and Spain) shows that its absence does not necessarily hinder the development of renewable energy [6, 52]. Local authorities have a strong incentive to accept wind farms in their territory: 2.5% of their annual revenue is awarded to municipalities. No such provision exists for solar power plants, which are negotiated on a case by case basis.

As mentioned in the framework section, several benefits and positive impacts for the local development of rural communities may derive from the implementation of renewable energy projects, from the more conventional ones (jobs, rents), to support and contributions ‘in kind’, to services provision to rural populations. However, in all four cases, and despite their diversity, the benefits and positive impacts are perceived as indirect and quite modest. This is clearly the case of job creation, particularly at the local level:
No, at that level, it didn’t bring any… there was no job creation, except for one or two cases, but even in those cases the employees are not from this area. (Interview WFSF, mayor of Arouca #1)

Here, in Fafe, the impact is not that large. Why? Because the company that manages the park is Spanish, so the added value and the taxes are paid not here, not in Portugal, and the majority of the employees are from also from Spain. (Interview WFTAF, local association #4)

In the case of the solar power plant, disagreement between the parish and the municipality is clearly observed. In fact, for the municipality and other municipal level stakeholders, job creation was one of the major assets deriving from the implementation of the project (which gave rise to a solar panel assembly plant and a technological park in Moura), whereas for the parish council of Amareleja these impacts were very low:

The power plant and the factory, well, they had some positive impacts here in terms of job creation and in terms of improving local population’s quality of life. (Interview SPPA, mayor of Moura)

To tell you the truth, there are 10 or 12 persons that work there [in the solar power plant] that are from here, from Amareleja, but… you see, the impact… in the beginning they were talking about the largest photovoltaic central in the world, and… you see… 10 or 12 local jobs… I don’t really see where the benefits are. (Interview SPPA, president of the parish council #1)

In all case studies, other benefits, such as the development of local commerce (conventional economic benefits), the co-production and ownership of the energy produced, support to local events, lower energy costs for local communities (economic benefits), support to the construction of infrastructures (contributions in kind) as well as the involvement of local populations in the development processes, are also perceived as extremely limited by local stakeholders and social actors:

Because people here… we were with our hearts wide open thinking that we would benefit from everything, from the costs in terms of electricity consumption… […] and I think that we even pay more and more for the electricity here. (Interview SPPA, president of the parish council #1)

It is a pity that the electricity costs don’t go down here… that we don’t have any benefit from the wind farm. It is only the municipality that receive some money… but the local residents who are close to the wind farm don’t have any benefit from it. (Interview WFTAF, president of the parish council #3)

Of course, it brought movement, people, during the installation… even now, there are always some people coming and going but… that is all. (Interview WFTAF, member of the municipal council)

Other type of benefits, of conventional character, as the additional revenues to the municipalities and landowners, are more often perceived as having positive impacts at the local level:
Well, the money that we have available now from the wind energy production that we can use for our budget, for the budget execution that we have… it is always a good contribution, I mean, what we receive corresponds to, I don’t know, maybe 30% of the revenues from the Municipal Taxes on Housing, so, if we receive three hundred thousand Euros from wind energy… it is very, very good. So, it has a positive impact in that matter. (Interview WFSF, mayor of Arouca)

The benefits that people have, from those lands, were from pasture and agriculture. The revenue they receive from renting that land is much, much higher than the one they used to receive from the pasture. For that… well I have to say there was change, yes. There is no pasture land left anymore but they have much higher revenue. (Interview WFTAF, parish president #5)

Despite the general positive perceptions regarding additional revenues, an ambivalence can be identified, deriving from the perceived unbalance between the gains at the municipal level and the gains at the parish level, from local stakeholders and residents, particularly in the cases where the projects were sited in ‘commons’ land:

It would be interesting, much interesting, if when they built the photovoltaic central… the local population of Amareleja received benefits… but they were very little, just a few ‘crumbs’… what we received were just a few ‘crumbs’ from everything, from this larger investment. (Interview SPPA, president of the parish council)

Benefits… only for the municipality in terms of inflow of money into their coffers. But the question is: is the inflow of money to the municipality a real benefit for us?! (Interview WFA, citizen who took part in the public consultation process)

In the particular case of the wind farm of Terras Altas de Fafe, there is also a perceived unbalance between the lack of benefits for the general local population and the benefits for owners of the (mainly private) land where the wind farm is sited:

Maybe it benefits the landowners, I mean, the owners of the land where the wind turbines are located. The parish in itself doesn’t benefit. They have fixed the road, okay, but apart from that, nothing. So they put those things up in the hill, isn’t it?!! […] Maybe we should pay less for the electricity and they should benefit more local communities here, a part of the money should be devoted to benefit the parishes, isn’t it?! (Interview WFTAF, president of the parish council #1).

From the previous excerpts it is also possible to observe the existence of some controversy and ambivalence regarding the ways in which the additional revenues are invested. At the same time, a mismatch between initial expectations and actual benefits is quite clear among local stakeholders:

They have redirected everything to Moura [the municipality] and that is unacceptable. Because if things begun here, they should continue here. (Interview SPPA, resident #1)

They promised they would repair the old schools […] but the schools are exactly the same as before. (Interview WFA, resident #6)
A relatively consensual benefit perceived by stakeholders and social actors interviewed refers to larger promotion of the areas, namely, through the development of territorial ‘brands’ closely related to the renewable energy production (as the ‘Land of the Sun’ in Amareleja or the ‘Trails of the Wind’ in the wind farm of Terras Altas de Fafe). The creation of this type of ‘brands’ is often related to the potential ‘demonstration effect’ pointed out by del Río and Burguillo [42], particularly associated with the development of educational projects (which exist in a more or less structured and organized way in all the four cases analysed and especially in the SPPA and WFTAF) and to the improvement of the touristic attractiveness of local territories. The following excerpt is particularly representative of the value attributed by local stakeholders and actors to territorial promotion:

We received the visit of the Japanese ambassador. And of the ambassador of Australia. We had here a group of 20 people from French municipalities […] We had here a group of students from various countries of the world, they visited the power station, then we had lunch here at the restaurant. (Interview SPPA, former president of the parish council)

Together with (and related to) the promotion efforts and the educational projects, the attraction of tourism seems to be perceived as a positive impact in all the cases studied, both because of the increasing number of visitors and tourists and the impacts it causes in local businesses:

All of this ends up in attracting more people who are coming to visit the solar power plant and, in some cases, people stay for a few days in the area and eat in local restaurants. (Interview SPPA, mayor of Moura)

In terms of visitors… yes, we have a lot of visitors here. During several years we had (I think that we still have now) bus tours, people coming from everywhere in the Ave Valley, to see, because it was the first wind farm in the area […]. On Saturdays and Sundays, we had here lots of tours. (Interview WFTAF, former member of the municipality council)

Some of the (limited) benefits and positive impacts on local development may be compromised by the type of ownership: the fact that the promoters of the energy infrastructures are mainly large national and international companies and they are generally seen as the main beneficiaries of the local exploitation of renewable energy sources. In fact, in all the cases analysed (including SPPA, despite its specific genesis), local stakeholders and residents point out a relative subordination of local interests and needs to external (national or large enterprises) interests:

Who benefited the most, in the first place, was the enterprise, SEALVE (Electric Society of Alvaízar) which is an anonymous society and we don’t know who is managing it, no one know who they are. (Interview WFA, citizen that was involved in the public consultation process)

It was certainly the enterprise that built the park [who benefited], no? Certainly! (WFSF, local association #4)
It has benefited all the country. It was a way to generate wealth for all the country. (Interview WFTAF, president of the parish #4).

Finally, the articulation between renewable energy production and other local activities seems rather limited in all the four cases studied (although more evident in the SPPA case), apart from the limited links with tourism and educational projects. One may therefore conclude that, in the cases studies, no sustainable local development processes emerged in a consistent and integrated manner from the exploitation of solar and wind energy.

5. Discussion and Conclusion

In the absence of data on resident’s perceptions of and attitudes towards wind and solar farms before their construction, we cannot ascertain how these have changed over time. However, the results section presents a fairly comprehensive picture of how communities envisage these infrastructures once they are up and running. Several points of convergence and divergence with the international literature can be pointed out.

First, we have found significant levels of indifference towards these energy facilities, even in residents living quite close to them. In fact, many interviewees failed to express an opinion regarding the renewable energy facilities located in their place of residence. If some responses can be attributed to mistrust of the researchers (and even fear of retaliation from supporters of facilities, namely, municipal authorities that are, in some cases, the main employer in the area), most seem to stem from a genuine lack of concern or interest in the issue. This is a kind of response that is commonly found in in surveys about these issues, particularly in southern European countries [6, 55]. But this also lends support to studies that stress the role of ‘vocal’, ‘powerful’ or ‘networked’ minorities in stopping wind energy developments despite a favourable or indifferent majority [7, 10, 26, 28, 50, 56 - 58].

In what regards environmental and health effects of renewables, residents and stakeholders seldom refer to negative impacts. Conversely, they are much more likely to characterise these energies as ‘natural’, ‘clean’ or ‘green’, claims that have also been found in studies conducted in other countries [4, 24, 59 - 63]. The contribution of their localized communities to solving a global problem (mitigating climate change) is valued, which points to a reversal of the trope found in the scholarly literature of ‘local sacrifice’ to ‘global interests’ [14, 37, 40, 63 - 65]. Residents also show a preference for wind and solar energy over nuclear and even other renewables that are perceived as more impactful (hydropower, biomass plants), an issue that is not often included in similar studies at the community level, though it is more frequent at wider scales [66 - 69].

Nevertheless, some residents voiced environmental concerns, notably about animal welfare, waste and the fate of disused materials. If the former is a commonly found argument in the literature concerning opposition to wind farms [15, 21 - 23], the latter is still very much absent from discussions. But, since most studies are carried out in the planning stage of wind and solar farms and Smart et al [70] have diagnosed a policy gap in this matter, the issues of decommissioning, waste management and contamination from hazardous materials are bound to be seldom addressed. This finding highlights the need to take into consideration community concerns that may be being overlooked by planners, policy makers and promoters.
Finally, regarding noise complaints, our findings are very much in line with the literature in this area [4, 28 - 32]. A common worry before wind farms are built, it proves to be real once the wind farms are operating, according to the residents who live nearby, though it does not affect the community as a whole and can be mitigated by placing restrictions on the siting of turbines.

In what concerns landscape and heritage, ambivalence is predominant among the communities we studied. Whereas some residents mourn the destruction of natural beauty, others find aesthetic value in the presence of wind turbines and solar panels, which can even become a tourist attraction. The detrimental effect of renewable energy generation technologies on heritage (e.g. [39]) and, above all, on landscape [3, 24, 39], is frequently mentioned as a negative outcome of energy transition in the literature. Wind farms and, on a lesser extent, solar power plants are considered to have a negative aesthetic/visual impact. Moreover, in what authors such as Devine-Wright [40 - 41] describe as 'place attachment’, there are cases where the conflict between these technologies and the landscape results from the change of sites or spatial elements connected to the affective domain and to individual and collective memory. However, in our case studies, as well as in other instances in the literature [2, 12, 14, 67], energy technologies in the landscape can be ascribed as well a positive aesthetic value, as symbols of progress, modernity and development.

Additionally, evidence suggests that landscape change is interiorized by many residents after the construction of infrastructures. This again concurs with the common finding in literature [1, 2, 4, 38, 71] that opposition to wind farms tends to be stronger before construction and decreases with growing familiarity with the infrastructures.

With respect to the socioeconomic impacts of wind and solar farms, the four cases analysed in this article show several types of ambivalence regarding the contribution of renewable energies to local development. In fact, the empirical evidence analysed here demonstrates that if, on the one hand, one can point out the perception of some positive social and economic impacts on local development, particularly related to the creation of jobs and additional revenues for the municipalities, on the other hand, these impacts are often seen as limited and unequal. The first may be explained by the geographical location of all the study cases in remote rural areas with long lasting demographic, socioeconomic and development problems. In this context, the creation of employment opportunities tends to be valued, even if those opportunities are limited and scarce, which is in line with the findings of del Río and Burguillo [42]. Another ambivalence may be identified regarding the benefits in terms of job creation between the stakeholders at municipal level, who tend to value more this aspect, and the parish councils and local populations, that perceive those benefits as much more scarce. This is particular evident in the solar power plant case.

Several other benefits and positive impacts for local development may derive from the exploitation of renewable energies, from more conventional ones (rents) to support and services provision for rural populations [42 - 43]. However, as shown in the previous section, these benefits and impacts (except the increasing of revenues to municipalities and landowners) are also generally seen as modest, which is again in line with the conclusions of del Río and Burguillo [42]. A fourth ambivalence, also pointed out in the works of Brown [11], del Río and Burguillo [42] and Gross [72], may be identified in the cases analysed concerning the distribution of this type of benefits. This particular
ambivalence results from the perceived unbalance between the gains at the municipal level and the gains at the parish level, as well as between the scarce benefits for the general local population and the benefits for owners of the (mainly private) land where the infrastructures are implemented, the latter being more evident in the Terras Altas de Fafe case.

The analysis of the four cases demonstrates that one of the most common benefit perceived is the contribution of the renewable energy to foster the promotion of the communities, namely, through the development of specific ‘brands’ related to the wind and solar plants (‘Land of the Sun’ in Amareleja or the ‘Trails of the Wind’ in the wind farm of Terras Altas de Fafe). This is clearly linked to the ‘demonstration effect’ pointed out by del Río and Burguillo [42] and it is specifically associated with the development of educational projects and tourism attractiveness.

Some of the scarce positive impacts perceived may be compromised by the fact that in all the cases the main promoters of the energy infrastructures are large national or international companies, as also demonstrated in the works of Szarka [45] and Komor and Bazilian [73]. They are generally seen, at the local level, as the main beneficiaries of renewable energy exploitation. This circumstance, together with the absence of links between energy production and local economies and activities, as well as with the perception of a substantial unbalance in the distribution of benefits, leads to the consideration that the production of renewables in Portugal did not provide, up to now, a significant contribution to sustainable local development. Apart from the limited links with tourism and educational projects, no other significant articulations seem to exist between renewable energy exploitation and other local communities’ activities. One may conclude that in the case studies no sustainable local development processes emerged in a consistent and integrated manner from solar and wind energy, taking into account what Kitchen and Marsden [44], as well as Munday et al. [43], refer in terms of the requisites to promote and to foster local sustainable development based on the exploitation of renewable energies. In the cases analysed, not only the benefits and positive impacts for local communities are generally seen as limited, but the existing ones are seen as not equally and fairly distributed, conclusions that are in line with the findings of other studies [11, 42 – 43, 73]. This also corresponds to a feeling of unfulfilled expectations, particularly among local populations and stakeholders, as well as to a perception of local subordination to more global and almost always external interests, therefore contributing to reinforce the long-lasting marginalization of many rural territories.

In short, this article set out to provide an empirically sustained contribution on the community perceptions of renewable energies, with reference to a southern European country. The study has shown that community perceptions of renewable energies in Portugal are characterised, first and foremost, by ambivalence. Diverse, and even opposite, opinions can be found within the communities. And if the institutional framework already diverged strongly from other successful cases of wind and solar energy implementation in Europe [6], the reactions of local communities to wind farms and solar power plants also seems to be distinctive.

We sought to demonstrate that studies conducted after the infrastructures are built offer relevant insights into factors for social acceptance or rejection of wind and solar farms and can provide recommendations to be implemented also in the planning stages. For instance, our findings underline the importance of providing accurate information to
communities regarding both positive and negative impacts (in order to adjust expectations), of developing mitigation strategies to address the specific concerns and complaints of residents and of ensuring distributive justice, guaranteeing that benefits indeed reach the community and not just a few private interests.

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