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EMERGING RENEWABLE ENERGY LANDSCAPES IN SPAIN[1]

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Over the last 15 years a framework that is most conducive to the development of renewable energies (RE) has been constructed in Europe, in response to widespread concern about how to deal with a number of serious energy challenges. European RE policies have been very successful in Spain, which has become a leader in the installation of the latest renewable electricity production systems, above all in wind, solar photovoltaic and solar thermal technologies. At the end of 2013 Spain had an installed power capacity of 108,173 MW, 94.5% of which was produced in power plants located on the Spanish mainland.

The development of renewable energy in Spain has been so intensive that almost half (46.8%) of installed power is now produced using these technologies. Wind power, most of which was installed in the first decade of this century, and large-scale hydropower developed during the second half of the 20th Century are the main renewable sources, while solar (photovoltaic and thermal), small-scale hydro, biomass and waste also make an important contribution.

However the RE policies applied in the 2000's have shown certain limitations. The political and economic framework for RE deployment has proved unstable and subject to numerous fluctuations. Even the governments that offered the most generous incentives to development are now cutting back or phasing out incentive schemes, while at the same time heeding the complaints of conventional energy companies who claimed to have been harmed by RE poli-

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cies. As a result in some countries such as Spain the RE sector has collapsed, with the bubble bursting in a similar way to the boom and bust in property.The result is that after more than a decade with a political and institutional framework that favoured renewable development, recent measures to contain and limit the growth of RE have raised questions as to the viability of the Spanish National Renewable Energy Action Plan 2011–2020 (2010). Nonetheless, from a research point of view this parenthesis in the development of renewable energy systems offers an excellent opportunity to analyse the initial lessons to be learnt from the boom in new energies in Spain and their important consequences on the territory and the landscape.

Renewable energies have a wide array of benefits that have been studied by numerous authors. Nonetheless the transition from conventional to renewable energy sources also has a series of costs: higher electricity bills; the costs of restructuring electricity infrastructures; new uses of agricultural land and offshore areas, high visual impact and assorted environmental costs. In addition, numerous studies have revealed that the production systems used with some renewable energies are clearly unsustainable because they are based on fossil fuels and consume other resources such as water, land and landscape. At the same time, the infrastructures linked to the RE introduce new dimensions in land use planning and landscape policies, as they are normally smaller and more disperse than conventional power systems. Lastly, the continued growth of the RE sector in different countries and the increased scale of the industrial applications of renewable energy technologies, which are getting larger and larger and often more expensive, increases the likelihood of conflicts and tensions (Van der Horst y Lozada-Ellison, 2010). For all these reasons, the transition to a new energy model is having a huge impact on the social, economic and geographical landscape in Europe in general and in Spain in particular.

In Spain the resistance to RE generation plants from some sections of the population, especially to wind energy, has intensified above all in regions in which there is already a high density of such installations, leading to serious conflicts relating to their incompatibility with existing land uses or with certain local business activities, or in which opponents view these projects as unfair exploitation of local resources for the benefit of external agents. The arguments they put forward are often very varied and go beyond purely aesthetic considerations.

The objective of this article is to study the relationship between RE and the landscape in Spain so as to analyse the new aspects that must be taken into account to improve energy and landscape planning. With this in mind, we investigate RE planning instruments and the existing documents and data and we review the relevant Spanish and international bibliography about emerging RE landscapes.

Our research is based on the idea that the renewable energy landscape is a complex system which transcends purely visual aspects to reflect socioeconomic and environmental exchanges, interrelations and dynamics at different space and time scales.

We begin by analysing the concept of renewable energy landscape as defined in the most recent studies on this subject, at both a national and an international level. We discuss the different forms of RE landscape and their main associated problems from a comparative viewpoint. We then conclude by outlining the main challenges that must be faced in order to achieve a more harmonious relationship between new energies and landscape.

In Spain, the deployment of new forms of energy has illustrated the links and the tensions between energy, territory and landscape. Recent publications by Spanish geographers

(Ardillier, 2011; Iglesias *et al*., 2011; Prados *et al*., 2012; Zografos y Saladié, 2012; Mérida y Lobón, 2012, among others) reflect the general concern about the scale of landscape and territorial transformations arising from RE development in Spain over the last decade. Trends in Spanish research echo those in other European countries. Landscape is frequently used as an aesthetic or environmental argument against the development of RE projects, perceived as industrial installations whose impact must be limited. Despite this, recent studies conducted in Spain (Frolova *et al*., in press) show that in some cases turbines are not seen as a problem and can in fact play a part in the construction of local identities and landscapes.

In this context qualitative methodologies are becoming increasingly popular in studies on RE landscapes.These analyses focus on the analysis of the perception of renewable energy landscapes and their acceptability (Frolova y Pérez, 2011; Frolova *et al*., in press) and demonstrate the need for in-depth research into the social perception of renewable energies and the need to improve the procedures for local participation involving all stakeholders in the decision-making process.

The energy transition is based on different types of RE, each of which transforms the territory and landscape values and practices in its own specific way.

The first renewable energy form to be developed in Spain was hydropower, from which a lot of valuable lessons have been learned (Pillai *et al*., 2005; Warren *et al*., 2005; Frolova, 2010; Espejo y García, 2010). This energy sector was consolidated before 1980 in very different political, social and economic circumstances. It is the only existing renewable energy technology that emerged and expanded in a completely decentralized context, in an era when energy production and consumption were approached on a local territorial scale. This resulted in the development of a set of specific, interrelated elements such as hydropower stations, water reservoirs, dams, pipelines, water diversion channels... that progressively made up what today can be perceived as authentic energy landscapes.

For its part, wind power, by virtue of its scale, is the first decentralized energy technology to «concentrate hazards-in the form of very large clusters of very large turbines- while distributing the benefit of electricity primarily to far-off populations who do not experience… the altered views, land-use changes, ecosystem damage, noise, optical effects, and risk of accidents that come from the 400-foot high structures» (Ottinger, 2013: 224).

During the 2000's solar energy (above all ground-based photovoltaic) also entered the phase of large-scale development. Medium-sized and large ground-based solar PV farms share some characteristics with wind farms, in that they are largely unrelated with public good, territorial scale and energy demand and they have a substantial visual impact (Torres-Sibille *et al*., 2009b; de Andrés e Iranzo, 2011; Mérida, 2012). Unlike wind farms, which are often compatible with the previous use of the site, solar PV and solar thermal farms sited in previously cultivated are as implicitly involve a change in land use (Prados, 2010) and a reduction in the potentially cultivable land area (Tsoutsos *et al*., 2005). For this reason, many researchers claim that electricity production in these farms is competing for land with food production, establishing comparisons with the growing of energy crops (Blueming *et al*., 2013, Chiabrando *et al*., 2009).

Finally, as in the case of solar energy in its different forms, bioenergy produces direct changes in land use on the sites that have been specially modified for its production. However, bioenergy is special in that it also induces indirect land-use changes when biofuel

production replaces existing crops with new, often more intensified forms of agricultural production (Palmer, 2014). Moreover bioenergy is closely related not only with energy and environmental policies (including landscape), but also with agricultural policy. Unlike other renewable energy sources, agricultural biogas belongs to the agricultural sector and depends on its institutional structures and farming practices (Blueming *et al*., 2013).When bio-ethanol is produced on a large scale, its production becomes disassociated from the local community (Bluemling *et al*., 2013; Carrosio, 2013). Doubts have been raised about the authenticity of the environmental and socioeconomic credentials of bioenergy due not only to the lack of coordination of the policies regulating its development, but also to other more global issues, such as competition between energy and food production (for land and water), environmental impact (through GHG emissions, soil and water resource degradation, biodiversity loss, landscape impact etc.) and social consequences (through land rights infringements, local and regional food security impacts, etc) (Palmer, 2014).

The analysis of the studies of the consequences of the deployment of renewable energy systems in Spain shows that a variety of issues must be addressed and numerous obstacles overcome. Several challenges must still be faced if we are to achieve the desired balance between new energies and landscape. We believe that a different model of renewable energy development must be adopted, within a framework that seeks to reduce wasted energy consumption. Development in line with needs, as well as having less impact on the landscape, has great potential as a means of rationalizing production and consumption. When compared to plants that produce above and beyond these needs, smaller plants can reduce costs, increase local income in the long-term and help maintain small farms.

This takes us on to a second challenge, namely to investigate the relationship between renewable energies and local development. Although RE is a relatively new business sector, it already has a strategic role in the economy and is enormously complex, as it encompasses forms of energy with very diverse economic, social and territorial impacts and characteristics. Given the absence of previous data and the difficulties associated with its study, specific analysis tools must be designed or other existing tools must be carefully adapted to this purpose (Arregui, 2009). Our future research will follow these lines, seeking to create a solid theoretical base to enable geographical studies of this sector to be extrapolated and compared. Last of all, we will be working on the development of the legal instruments and clear criteria required to guarantee correct territorial and landscape planning of renewable energies.

The first step is to acknowledge that renewable energy planning is affected by the absence of real territorial and landscape policies relating to its deployment. Landscape practices and values are of increasing importance and in the interests of improved territorial management it is important to gain a deeper insight into the problems associated with them. Although important efforts have been made in the EU on landscape issues, often hand-in-hand with the need to promote renewable energy sources, and legislation on this question has proliferated, landscape has not become a transversal aspect of the energy policies of its different member states. Spain's signing of the European Landscape Convention in 2000 and its ratification in 2008 urges us to incorporate landscape into land use planning via the development of specific legislation on landscape at a national level that incorporates energy planning in a generalized transversal manner.