Marina Frolova · María-José Prados
Alain Nadaï *Editors*

Renewable Energies and European Landscapes

Lessons from Southern European Cases

Springer

Renewable Energies and European Landscapes

Marina Frolova • María-José Prados
Alain Nadaï
Editors

Renewable Energies and European Landscapes

Lessons from Southern European Cases

Springer

Editors
Marina Frolova
Regional and Physical Geography
University of Granada
Granada, Spain

María-José Prados
University of Sevilla
Sevilla, Spain

Alain Nadaï
CIRED-CNRS (Centre International de Recherche sur l'Environnement et le Développement)
Nogent-sur-Marne CEDEX, France

ISBN 978-94-017-9842-6 ISBN 978-94-017-9843-3 (eBook)
DOI 10.1007/978-94-017-9843-3

Library of Congress Control Number: 2015941900

Springer Dordrecht Heidelberg New York London

Printed on acid-free paper

Springer Science+Business Media B.V. Dordrecht is part of Springer Science+Business Media (www.springer.com)

Acknowledgements

This book originated in Spain in a series of seminars and workshops organized by the Spanish Network on Renewable Energies and Landscape (RESERP). These seminars, which began in 2010, focused above all on wind and solar power landscapes.

The RESERP network was created as a follow-up to an exploratory workshop about the emerging landscapes of energies (EW06-218-LESC) funded by the European Science Foundation (ESF) and organized by CIRED in 2007 (Nogent-sur-Marne, France). Its aim was to provide a platform to enable the various participants to share their wealth of experience.

RESERP and CIRED have organized a number of workshops and Special Sessions at international conferences since 2010. The RESERP network has been funded by Spanish Ministry of the Economy and Competitiveness (Grant Codes CSO2009-06356-E and CSO2010-09939-E). Additional financial support was provided by the projects sponsored by Spanish Ministry of the Economy and Competitiveness (Grant Code CSO2011-23670 and CSO2011-28480) and the French government and the Atelier International du Grand Paris (Research Programme IMR Ignis Mutat Res, Project 'Ressources paysagères et resources énergétiques dans le montagnes sud-européennes. Histoire, comparaison, expérimentation'). We are also grateful to the 'Conseil Français de l'Energie'; the French Ministry for the Environment (MEDAD – Programme PDD, 'Paysage et Développement Durable'); the French Agency for the Environment and Energy (ADEME); and the Ile-de-France Region (R2DS). The support of all these institutions allowed us to extend the range of studies on renewable power landscapes and to include a number of international experts from European countries, mostly from Southern Europe.

Many of the chapters in this book build on papers presented at these workshops, and we are very thankful to all the participants for their valuable insights. We are very grateful to everyone involved in these workshops, although it would be impossible to name everyone.

We would like to express our gratitude to Nigel Walkington for his translation work and in-depth review of the English text. The book would not have been possible without the patient work of Enrique Fernández Seguí who formatted the text.

We would like to thank our own host universities and research centres for the support that they provided. Special thanks are due to the Department of Regional and Physical Geography and the Institute of Regional Development of the University of Granada, University of Sevilla and CIRED. We also want to thank the Observatorio de la Sostenibilidad en España (now defunct); the Department of Geography at the University of Alcalá de Henares, especially Professor Joaquín Bosque Sendra; the University of Alicante; the Association of Spanish Geographers; and the Colegio de Geógrafos Españoles, in particular Antonio Prieto Cerdan, without whose support and hospitality we might not have been able to organize the first two RESERP seminars in 2010 and 2011. We are also indebted to ADESS – UMR 5185 du CNRS; Institute of Regional Development of University of Granada (Spain); and Research Unit 'Governo e Governance delle trasformazioni del paesaggio' – Università IUAV di Venezia for supporting our workshops held between 2012 and 2014.

Contents

Contributors

Ana Isabel Afonso FCSH - CICS.NOVA, Universidade Nova de Lisboa, Lisbon, Portugal

Véronique André-Lamat ADESS – UMR 5185 CNRS/University of Bordeaux, Pessac Cedex, France

Eugenio Baraja-Rodríguez Departamento de Geografía, Facultad de Filosofía y Letras, University of Valladolid, Valladolid, Spain

Serge Briffaud ADESS – UMR 5185 CNRS/University of Bordeaux – CEPAGE – ENSAP Bordeaux, Pessac Cedex, France

Benedetta Castiglioni Dipartimento di Scienze Storiche, Geografiche e dell'Antichità – sez. di Geografia, Università di Padova, Padova, Italy

Bernard Davasse ADESS – UMR 5185 CNRS/University of Bordeaux – CEPAGE – ENSAP Bordeaux, Pessac Cedex, France

Carles de Andrés-Ruiz wpd SAS, Limoges, France

Michel Deshaies University of Lorraine, Nancy, France

Pilar Díaz-Cuevas Dpto. de Geografía Física y Análisis Geográfico regional, Universidad de Sevilla, Seville, Spain

Javier Domínguez-Bravo Departamento de Energía, División de Energías Renovables, Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT), Madrid, Spain

Cayetano Espejo-Marín Facultad de Letras, University of Murcia, Murcia, Spain

Viviana Ferrario Dipartimento di Culture del Progetto, Università Iuav di Venezia, Venice, Italy

Marina Frolova Dpto. Análisis Geográfico Regional y Geografía Física, Facultad de Filosofía y Letras, Universidad de Granada, Granada, Spain

Emmanuelle Heaulmé ADESS – UMR 5185 CNRS/University of Bordeaux – CEPAGE – ENSAP Bordeaux, Pessac Cedex, France

Daniel Herrero-Luque Departamento de Geografía, Facultad de Filosofía y Letras, University of Valladolid, Valladolid, Spain

Emilio Iranzo-García Facultad de Geografía e Historia, University of Valencia, Valencia, Spain

Yolanda Jiménez-Olivencia Facultad de Filosofía y Letras, Universidad de Granada, Granada, Spain

Olivier Labussière IGA – Institut de Géographie Alpine – Laboratoire PACTE, Grenoble, France

Rafael Lobón-Martín LDV Arquitectura y Paisaje S.L., Estepona, Málaga, Spain

Carlos Mendes Centro de Estudos Comparatistas (FLUL), Instituto Politécnico de Viana do Castelo, Viana do Castelo, Portugal

Matías Mérida-Rodríguez Departamento de Geografía, Facultad de Filosofía y Letras, Universidad de Málaga, Málaga, Spain

Alain Nadaï CIRED-CNRS (Centre International de Recherche sur l'Environnement et le Développement), Nogent-sur-Marne CEDEX, France

Santiago Pardo-García Departamento de Geografía, Facultad de Filosofía y Letras, Universidad de Málaga, Málaga, Spain

Belén Pérez-Pérez Facultad de Filosofía y Letras, Universidad de Granada, Granada, Spain

María-Jesús Perles-Roselló Departamento de Geografía, Facultad de Filosofía y Letras, Universidad de Málaga, Málaga, Spain

Daniela Perrotti French National Institute for Agricultural Research, INRA Versailles-Grignon, Research Network R2DS, Île-de-France Region, UMR SAD-APT INRA/AgroParisTech, Ivry-sur-Seine Cedex, France

María-José Prados Universidad de Sevilla, Sevilla, Spain

Matelda Reho Dipartimento di Culture del Progetto, Università Iuav di Venezia, Venice, Italy

Alfredo Requena-Galipienso Facultad de Filosofía y Letras, Universidad de Granada, Granada, Spain

Sergio Reyes-Corredera Departamento de Geografía, Facultad de Filosofía y Letras, Universidad de Málaga, Málaga, Spain

Isabelle Sacareau ADESS – UMR 5185 CNRS/University of Bordeaux – CEPAGE – ENSAP Bordeaux, Pessac Cedex, France

Miguel-Ángel Sánchez-del Árbol Facultad de Filosofía y Letras, Universidad de Granada, Granada, Spain

Belén Zayas-Fernández Departamento de Geografía, Facultad de Filosofía y Letras, Universidad de Málaga, Málaga, Spain

Part I
Conceptualising Renewable Energy Landscapes

Chapter 1
Emerging Renewable Energy Landscapes in Southern European Countries

Marina Frolova, María-José Prados, and Alain Nadaï

Abstract We explore the process of emergence of renewable energy landscapes in various countries in southern Europe, focusing on the tensions this has caused, on the role of the institutional settings in the different countries and on evolving landscape values and approaches. We present a thorough analysis of the heterogeneous and multidimensional process of construction of energy landscapes and explore the different kinds of energy landscape emerging today. We then explain the structure of the book and conclude by setting out some of the challenges ahead for renewable energy planning.

Keywords Landscape practices • Landscape values • Renewable energy landscapes • Processes • Territorial planning of energy • Southern Europe

1.1 Introduction

The recent emergence of EU climate and energy policy has triggered a spectacular growth in renewable energies. Their rapid expansion in southern European countries is largely due to favourable national policies, based on quantitative targets and economic incentives (feed-in tariffs) as well as more or less favourable social, institutional and political conditions. Over a decade, decentralised energy infrastructures have spread through rural areas, transforming the physical

M. Frolova (✉)
Dpto. Análisis Geográfico Regional y Geografía Física, Facultad de Filosofía y Letras, Universidad de Granada, Campus de Cartuja s/n. 18071, Granada, Spain
e-mail: mfrolova@ugr.es

M.-J. Prados
University of Sevilla, María de Padilla s/n, 41004 Sevilla, Spain
e-mail: mjprados@us.es

A. Nadaï
CIRED-CNRS (Centre International de Recherche sur l'Environnement et le Développement), 45 bis, avenue de la Belle Gabrielle, F-94736 Nogent-sur-Marne CEDEX, France
e-mail: nadai@centre-cired.fr

M. Frolova et al. (eds.), *Renewable Energies and European Landscapes*,
DOI 10.1007/978-94-017-9843-3_1

landscape. This has raised issues regarding landscape practices and the values that were or should have been associated with landscape protection. These infrastructures have often been a source of tension, triggering the emergence of new attitudes towards landscape and of new stakeholders in the energy sector. Support for or opposition to the development of these new energies and the transformation of everyday landscapes has varied greatly depending on the country.

The role of landscape practices and values in spatial planning and permission processes, with varying degrees of public participation, has yet to be thoroughly analysed. Analysts in northern European countries have investigated these processes and their impact in countries such as Denmark, Germany, the Netherlands and the United Kingdom. Several recent books have explored the economic, environmental and landscape implications of the development of renewable energies, the issues they raise for planning and social acceptance (Szarka 2007; Strachan et al. 2009; Devine-Wright 2011; Bouneau et al. 2012; Szarka et al. 2012; Stremke and van den Dobbeisteen 2012) and even their technical dimension (Carriveau 2012). Yet the experience of southern European countries has not been explored and subjected to transnational comparison to the same extent.

This book intends to fill these gaps by analysing the situation in southern European countries, focusing particularly on landscape issues. The book provides an interesting insight into the relations between different types of landscape culture, degrees of political centralisation, renewable energy development processes and renewable energy landscapes. It includes case studies from Spain which have so far not been presented to English-speaking audiences in spite of Spain's leading role in renewable energy development. It explores the processes through which renewable energy landscapes have emerged in different southern European contexts and examines the lessons to be learnt by comparing the development of different renewable energy technologies in southern Europe and its relationship with landscape changes. It focuses not only on wind power, often the main subject of books dealing with the impact of renewable energy technologies on the landscape (Pasqualetti et al. 2002), but also provides a round-up of current research into the landscapes being produced by other forms of renewable energy, such as solar photovoltaic, solar thermoelectric, hydro and biomass energies, including biofuel and biogas. The book has been written by a multidisciplinary team and covers a wide range of social, cultural and political aspects of the relationship between renewable energy and landscape. The 13 case studies carried out by researchers from Spain, France, Italy and Portugal analyse these questions on different political and geographical scales, relying on a wide range of disciplinary approaches, such as history, geography, sociology and anthropology (actor network theory, sociological and anthropological qualitative studies), GIS-based approaches and landscape assessment methods.

On the basis of case studies from these countries, the book explores the institutional and social processes through which renewable energy landscapes have emerged. It analyses the way in which and the extent to which the development of renewable energies has affected landscape forms and whether or not it has contributed to a reformulation of landscape practices and values. France is considered here as a southern European country, given the common roots of the landscape concept in the Romance languages and various similarities in social practices and public policies related with landscape (Martinet 1983; Brunet 1995; Frolova et al. 2003).

The chapters explore the landscapes that are now emerging with the development of renewable energy technology in diverse geographical contexts – mountain, plain and coastal areas – and explain the differences between exceptional protected landscapes and the more 'normal' landscapes we encounter in our everyday lives. The authors demonstrate that landscape is both an aesthetic issue in the spatial planning of renewable energies and an object that is deeply embedded into local practices. The book shows that there are strong differences in the development of the different renewables as well as in their effects on landscapes.

Spain is a particularly striking example, given the huge strides it has made in hydro, wind and large-scale solar power development. Seven chapters of the book are dedicated to the effects of this development on Spanish landscapes and planning practices. Italy also provides interesting case studies on how hydro, solar power and agro-energies (biomass, biogas and biofuel) have been reshaping Italian landscapes, including the changing relationship between communities and the territory in which they live and work. The Portuguese case study highlights the various extents to which the development of wind farms in communal lands in Northern Portugal has contributed to empower local communities. Case studies from France point to the problems raised for French national landscape protection policy by the development of decentralised renewable energies. Last but not least, there are case studies that provide a historical outlook on the construction of certain renewable energy landscapes – notably, hydropower landscapes.

1.2 Emerging Renewable Energies in Southern European Countries

Since 1990, many European countries have adopted and implemented policy frameworks in order to initiate a transition to more sustainable energy systems. These have often included ambitious renewable energy support programmes, such as feed-in tariffs. In 2001, the European Union implemented its first renewable electricity directive. This was followed in the mid-2000s by the application of several directives aimed at liberalising the electricity sector and allowing new entrants to produce and sell new types of energy. In 2009, new renewable energy regulations were established as part of the 'third energy package', which included mandatory targets for Member States in terms of energy saving (minus 20 %), renewable production (20 % of EU final energy consumption) and the reduction of greenhouse gas emissions (minus 20 %) by 2020. The overall EU target of 20 % final energy consumption from renewable sources by 2020 was allocated to the different Member States according to their current mix and potential for contribution. In southern Europe, the targets vary from 17% in Italy and over 20 % in Spain and France to 31 % in Portugal. While these targets are subject to constant evolution, as has happened in

Table 1.1 Cumulated installed wind power capacity in various southern European countries (MW)

	2000	2005	2010	2013
Italy	363	1,639	5,814	4,630
France	48	873	5,979	7,821
Spain	2,296	10,095	19,706	22,785
Portugal	No data	1,047	3,863	4,630

Sources: France: SER, L'énergie éolienne en France – Panorama 2013, http://www.enr.fr/docs/2013122234_SERCarteEolien20132.pdf, consulted 2014-07-08; Italy: Gestore Servizi Energetici, Rapporto Statistico 2012. Impianti a fondi rinnovabili. Settore Elettrico, www.gse.it, consulted 2014-07-29 and The European wind energy association. Wind in Power. 2012 European statistics, February 2013, www.ewea.org, consulted 2014-07-29; Spain: Comisión Nacional de los Mercados y la Competencia, http://www.cnmc.es/; Portugal: Direcçao Geral de Energia e Geologia. Renováveis, Estatísticas rápidas, 2014, n° 106, consulted 2014-07-29

the recent 2030 EU framework (UE 2014),[1] they have already led Member States to define, adopt and implement ambitious renewable energy policy frameworks, which have had profound social, economic and environmental consequences (Warren et al. 2012). For instance, feed-in tariffs for renewable energies – most often wind power or solar PV – have been introduced in Spain (1994–1997), France (2001), Portugal (2001) and Italy (2005).

While successful, the development of renewable energy capacity has been influenced by a range of complex cultural, contextual, socioeconomic, political and physical factors (Ellis et al. 2007), which have made it rather uneven, with the pace and the extent of development varying greatly from one Member State to the next, as can be seen in the countries we have analysed (see Table 1.1).

Apart from the obvious need for an abundant supply of the resource, other important factors in the development of renewable energy include the type and the scope of financial support systems, the form of development and the extent of benefit sharing (whether cooperative or through private developers) (Bolinger 2005; Meyer 2007), the values attached to landscape quality and preservation. The approach to spatial planning and its ability to take into account existing landscape practices, public participation and local potentials has also been important (Nadaï 2012; Labussière and Nadaï 2014; Toke et al. 2008; Wolsink 2007). In several southern European countries, the absence of conventional energy sources, the significant dependence on imports (e.g. Portugal on oil, Spain on gas, etc.) coupled with the significant and underexploited renewable energy resources (e.g. solar, wind) and the progressive emergence of leading industrial actors in the renewable energy technology field (e.g. Spain's wind turbine manufacturers Gamesa and Ecotecnia) have also been supporting factors.

[1] While increasing the overall EU target to 35 % of EU final energy consumption, this document does not allocate mandatory targets.

1.3 Increasing Tensions and the Debated Role of Institutional Settings

The development of renewable energy capacity has raised tensions and issues in many countries. One tangible consequence of this development has been the transformation of rural landscapes. Energy planning systems, which are often based on engineering and economic considerations, are difficult to match with land-use planning, especially on a local scale. In many European countries, spatial and energy planning cannot deal with such changes without reconsidering in one way or another the values, representations and practices on which they are based (e.g. Cowell 2009, for Scotland; Nadaï and Labussière 2012, for France; Wolsink 2010, for the Netherlands; Soderholm et al. 2007, for Sweden; Smith 2007, for the United Kingdom; Nadaï et al. forthcoming, for Germany and Portugal; Frolova Ignatieva et al. 2014, for Spain).

The situation in southern Europe has not been analysed to the same extent. Spatial and energy planning systems vary from one country to the next. In Spain, energy planning is the responsibility of the Central Government, although the regions play a very important role in the decision-making process. Local governments (municipalities) on the other hand play only a secondary role in the authorisation procedure, which at times has resulted in a lack of awareness of project development and the absence of strong opposition to renewable power projects (Frolova and Pérez Pérez 2011; Iglesias et al. 2011). In France, in spite of a recent move towards regionalisation, energy planning remains a State prerogative. Spatial planning is in the hands of a multilayered range of territorial entities, from municipalities to natural regional parks or regional authorities. Yet permit authorisation, the responsibility of the local administration (department Prefect), continues to be an essential prerequisite for renewable energy project development. While including provisions for public participation, such as a public inquiry or the possibility to petition the local State representative, the channels and the framework within which this participation takes place have been the subject of criticism (Nadaï and Labussière 2009 and forthcoming).

A number of research papers have shown how positions of support and objection to renewable energy projects are not constructed merely out of a lack of awareness of the benefits provided by renewable energy development, scepticism towards the technology or a disagreement about the proposed location of a specific project. They also reflect wider disagreement about cultural values and institutional settings (Aitken 2010a; Aitken et al. 2008; Ellis et al. 2007; Devine-Wright and Devine-Wright 2006; Haggett and Toke 2006; Nadaï and Labussière forthcoming; Woods 2003).

Renewable energy projects impact on many different fields. As this book shows, they can affect tourism (Chap. 7 by Frolova et al. and Chap. 8 by Briffaud et al. in this volume), landscape or biodiversity protection (Chap. 5 by Labussière and Nadaï, Chap. 10 by Afonso and Mendes, Chap. 12 by Desshaies and Herrero-Luque and Chap. 13 by Iranzo-García et al. in this volume), the protection of natural and cultural heritage (Chap. 7 by Frolova et al. and Chap. 11 by Perrotti in this volume) and even property values (Chap. 3 by Baraja-Rodríguez et al. in this volume). Renewable energy projects are also associated with the competition for resources (soil, water, etc.) and to a perceived unfairness (social, economic, energy) in the way they are being developed locally (Gross 2007, Chap. 6 by Ferrario and Reho in this volume). Conflicts can emerge in relation to incoherent territorial planning resulting in different approaches to renewable energy development in neighbouring administrative areas or to its seeming incompatibility with protected areas (Chap. 3 by Baraja-Rodríguez et al. and Chap. 7 by Frolova et al. in this volume). Planning has also been accused of being a source of problems that are essentially external to the energy sector. The qualitative understanding of planning processes has also been downplayed in order to put the emphasis on procedural efficiency and on the barriers to development produced in some cases by complicated, lengthy planning procedures (Ellis et al. 2009; Nadaï 2012). The driving forces behind these conflicts are complex and depend on the context. Selman (2010) and Pasqualetti (2011) proposed several reasons for the opposition to renewable projects, for example, the rapid speed of landscape change that made it difficult to accept. Tensions and conflicts have also resulted from the generalised practice, all over Europe, of public engagement as a one-way process, the end results of which are predetermined (Ellis et al. 2007). When this occurs, renewable energy projects are often perceived by local residents as being imposed upon them by and for the benefit of people from outside the region (Chap. 6 by Ferrario and Reho in this volume).

1.4 The Contested Emergence of Renewable Energy Landscapes

Landscape issues have been and still are a salient issue in the development of some types of renewables, especially wind power. It is commonly accepted that the most frequent public concerns when weighing up their costs and benefits involve landscape values (Wolsink 2007). Strong and effective opposition to wind power developments is also considered to be primarily rooted in landscape values (Toke et al. 2008), while M. Pasqualetti (2011) emphasises that the role of the landscape in the construction of local identities has had a negative influence on the acceptance of wind power projects.

Landscape-related objections became increasingly frequent in France and the UK in the early 2000s, before spreading to many other European countries. Even countries such as Denmark and Germany, which were renowned for their successful ‘civic’ model, based on the local ownership of wind farms, have faced issues of local acceptance in relation to the landscape. This change is related to an evolution in the physical dimensions of the turbines (the latest models are much bigger) as well as to a shift in the model of development of this form of energy, from small locally owned turbines to industrial-size turbines owned by private external developers (Möller 2010; Meyer 2007). Criticism has also been levelled at the way in which power was allocated to the different stakeholders by planning procedures and processes, notably in relation to the expert/nonexpert divide (Aitken 2010b). The fine-tuning of spatial and landscape planning has been one of the main challenges faced by policymakers when trying to establish the right level of decentralisation of renewable energy policy. This was made particularly difficult by the need to strike a balance between the obligation to meet previously announced national targets and varying local situations.

It is clear that landscape, which often expresses mismatches between national targets and local realities, must play a special role in the process of energy planning. Normative ('top-down') planning processes, often with a markedly hierarchical structure and reliant on existing landscape norms/values or classifications, have been shown to direct wind power deployment towards non-protected, allegedly 'less sensitive', areas and to increase social or environmental injustice. In different contexts and scales (Cowell 2009, for Wales; Nadaï and Labussiere 2009, for France), analyses of wind power planning processes have highlighted the ways in which landscape was represented in these processes. They revealed the strategic selectivity with which landscape qualities entered the planning rationales, favouring qualities that were formally mappable or even measurable 'at a distance'.

Conversely, cases of planning approaches based on participation (Nadaï and Labussière 2010) or responsive to specific local situations (Nadaï and Labussière 2013 and forthcoming) have been shown to contribute to the emergence of new landscape representations and norms that could be described as energy landscapes – i.e. landscapes of which renewable energy infrastructures are perceived and treated as part, even if these landscapes may face opposition (as shown by Bender 1998). The practices and values associated with landscape by different stakeholders play a role that requires further analysis in different contexts. Although landscape is often cited as an argument in the conflicts that grow up around renewable energy projects, especially around wind power projects, its relationship with these projects is not always conflictive. As comparative analyses have demostrated for wind power, this depends on the way in which both landscape and wind power are being institutionalised and constructed as shared, collective entities (Nadaï et al. forthcoming). Some of the case studies presented in this book (Chap. 7 by Frolova et al. in this volume) and an ongoing case study we are making in Cadiz (Spain)[2] show that wind turbines in a landscape not only may not be considered a problem for local inhabitants, but can even participate in the construction of a local identity. Another example is the perception of hydropower projects. As the case studies from France and Spain explored in this book emphasise, in some cases, renewable infrastructures (Chap. 8 by Briffaud et al. and Chap. 7 by Frolova et al. in this volume) have become genuine tourist attractions, paving the way for the emergence of new landscape values and practices.

[2] Research supported by the Spanish Ministry of Economy and Competitiveness (CSO2011-23670).

1.5 Evolving Landscape Values and Approaches

The values attributed to landscapes in southern European countries largely depend on national traditions of landscape protection and management, which are also related with the meaning of this concept in each language. The concept of landscape in the countries focused on in our book (Spain, France, Italy and Portugal) has the same origin as in the other Romance languages (*paisaje*, *paysage*, *paisagio*, *paisagem*): 'pais'/'pays' means 'land' in the sense of the bounded area of a region or country (Martinet 1983; Olwig 2002). The meaning of landscape is a deep-rooted aspect of the identities of the historical regions of southern Europe (Andalusia, Languedoc-Roussillon and Tuscany) from which the Mediterranean Landscape Charter emerged (Olwig 2002). Although landscape is approached in a different manner in each country, the policies for protecting it have been developed since the end of the nineteenth century along three main lines of thinking (Bouneau and Varaschin 2012):

- The picturesque paradigm, which considers landscape as a part of heritage endowed with a visual dimension, akin to *veduta* in painting. From this perspective, landscape has to be protected from visual interferences (co-visibilities) that could alter its visual appearance.
- The environmental paradigm, which considers landscape as a part of the environment, a natural habitat for wildlife and flora. It aims to protect this 'natural' landscape through the management of protected areas of different sizes (natural parks, biosphere reserves, etc.).
- The cultural paradigm, which considers landscape as the result of the interaction between nature and society: landscape is a part of the environment that has been shaped and endowed with shared meaning and values through cultural representations and territorial practices.

This third way of conceiving landscape is reflected in the European Landscape Convention (ELC). It defines landscape as 'an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors' (Council of Europe 2000: 3). This definition encompasses the picturesque approach that dominated for many centuries (Oles and Hammarlund 2011) and the environmental understanding of landscape. It reaches beyond the expert view of landscape as a purely material entity that has also been in use for several decades. It takes into account the importance of the perceptions of landscape by the people who share, value and use it (Olwig 2007). It includes the different dimensions of local identity and memory: landscape 'character' is not limited to visual features; it also includes the customs, habits, values and beliefs of people in particular places (Oles and Hammarlund 2011).

This new way of conceiving landscape has affected the approach to energy landscapes in southern Europe. At the beginning viewed as denaturalised and instrumental space (Pitte 1983), energy landscapes are increasingly perceived as 'holders' of sensibilities, thoughts and utopias deeply rooted in a territory. They also tend to be perceived as symbols of economic and social development (Varaschin and Bouvier 2009).

1.6 Energy Landscapes as Heterogeneous and Multidimensional Processes

In order to grasp these multiple dimensions of landscapes (Olwig 2002), recent analyses of renewable energy landscapes have portrayed them as heterogeneous and multidimensional – i.e. material, social, institutional, political and historical – processes embedded into a local area (e.g. Varaschin and Bouvier 2009; Nadaï and van der Horst 2010; Nadaï et al. forthcoming; Frolova 2010; Bouneau and Varaschin 2012). Such approaches are of great interest when it comes to understanding the relations between the processes that underlie the energy transition and the issues raised by the transformations they induce.

This book builds on this analytical strand. It presents a variety of interdisciplinary case studies in the field of renewable energy landscapes in order to highlight the changes in the landscape produced by the development of renewable energies and the issues this provokes, as well as the new ways of dealing with these changes.

Landscape is often invoked as an aesthetic or environmental argument against the development of renewable energy. According to this view, renewable energy projects are industrial installations, whose negative impact on landscape must be minimised. While such a distant and generic view captures part of the picture, it often does not stand up to closer examination. Project development and landscape processes are multidimensional. Lines of argumentation are multiple.

Landscape has also been progressively endowed with multiple dimensions and a new meaning in the assessment of renewable energy projects. For instance, in many southern European countries, the planning of renewable energy developments has been based on the use of geographic information systems, in order to identify potential areas or sites for future renewable power development (Chap. 15 by Díaz-Cuevas and Dominguez-Bravo in this volume). GIS compute and map the annual amount of sunlight, the wind speed and the physical characteristics of possible sites and also perform viewshed, proximity and density analyses (Möller 2010). However, they use a negative approach to land-use planning dubbed 'negative planning' and to analyses limited by existing administrative boundaries (Chap. 15 by Díaz-Cuevas and Dominguez-Bravo in this volume). These indices do not take into account the complex web of social, economic and cultural relations that people develop with energy and their environment (van der Host and Lozada-Ellison 2010; Moore 2013). The important progress made in landscape assessment methodology over the last decade offers new opportunities to take people's perceptions of their landscape into consideration. Landscape character assessment and historical landscape characterisation instruments and ecosystem cultural services (Gee 2010), for instance, have challenged to account for new dimensions of landscapes, attempting to objectivise these dimensions through classification and/or quantification. Nevertheless, many authors claim that there is still a substantial gap between the theoretical and political ambition to take on board people's perceptions and practices regarding their landscape and the current methodologies of landscape assessment, through which trained experts continue being given the power to define and evaluate landscape values (Olwig 2007). Ideally, the mission of landscape planners should increasingly be akin to that of an interpreter or a mediator, rather than that of a prescriptor (Claval 2011).

More generally, this issue reveals the shortcomings in our current understanding and approach to the potential for renewable energy development. The limits of the notion of technological potential itself have recently been the subject of controversy and reopened for debate. Some analyses have highlighted the role of inherited socio-spatial configurations in the emergence and the construction of this potential (Nadaï 2012; Labussière and Nadaï 2014). Traditions of landscape management vary greatly from one country to the next. Degrees of centralisation also vary as does the emphasis in one direction or the other on landscape and landscape processes. This book sets out to explore all these issues in different southern European countries and for different types of renewable energy, so enabling comparisons to be drawn.

1.7 Exploring Different Types of Energy Landscapes in Southern Europe

The energy transition is based on different kinds of renewable energy such as wind power, hydropower, solar PV and thermoelectric power and agro-energy (biomass, biofuel and biogas), each of which is dealt within one or various case studies in this book. These case studies show that each form of energy transforms the landscape in its own specific ways. In addition to the type of renewable energy, the impact also varies depending on the context and scale of development and the methods used. Lessons point to the complex, interwoven nature of the processes through which the joint assembly of a renewable energy capacity and a culturally shared landscape can be achieved.

1.7.1 Traditional Renewable Power Landscapes: Hydropower Landscapes

Until quite recently, the most developed renewable energy in southern Europe was hydropower. It first appeared towards the end of the nineteenth century in different contexts, making it today one of the most widespread but also the most 'traditional' renewable energy technology (Chap. 8 by Briffaud et al. and Chap. 7 by Frolova et al. in this volume). Its development was mostly concentrated in mountain areas, prior to the emergence of today's concerns about climate change and 'peak oil' (Warren et al. 2012).

Until quite recently (1970s), hydropower was considered to be one of the cleanest sources of energy. It was only in 2001, with the adoption of the first EU Directive on renewable electricity, that large-scale hydropower systems were removed from the official list of 'clean energy' technologies because of their significant impact with only small and mini hydropower systems continuing to be classified as green technologies (EU 2001).

Hydropower was developed and applied in quite a specific manner that evolved over time. In the early stages, hydropower plants were built as part of the electrification process, so establishing close links between hydropower production and the access to and consumption of electricity. This was no longer the case, however, in more recent hydropower development, which took place in a context in which even remote rural areas had already been connected to the grid.

Finally, it is the only existing renewable energy technology that emerged and expanded in a completely decentralised context, in an era when energy production and consumption were approached on a local territorial scale. This resulted, especially in mountain areas, in the development of a set of specific, interrelated elements such as hydropower plants, water reservoirs, dams, pipelines, water diversion channels, etc., that progressively made up what today can be perceived as authentic energy landscapes. The long historical process of hydropower development, its related conflicts and/or its acceptance by local people has contributed to the consolidation of hydropower landscapes as culturally constructed objects (Chap. 8 by Briffaud et al., Chap. 9 by Ferrario and Castiglioni and Chap. 7 by Frolova et al. in this volume). These landscapes have participated in the construction of specific identities, collective memory and history (Varaschin and Bouvier 2009), all of which have contributed to make hydropower landscapes part of our cultural heritage.

Hydropower therefore offers us useful lessons for understanding the complex set of relations that underlie the co-construction of renewable energy capacity and culturally shared landscapes.

1.7.2 New Renewable Energy Landscapes

The case studies presented in this book reveal a key difference between the historical development of hydropower and the current development of new energy technologies such as wind and solar power or biogas.

Hydropower production was developed in a way that took territorial scales and local demand for electricity into account. It was promoted politically as part of the action, mission and agenda of the Welfare State: that of providing all citizens with affordable access to comfort and modernity – think of the equivalent kWh in many European countries. By contrast, the 'new' renewable energies are less clearly associated with public good (the benefits from reducing climate change are less tangible than those brought by electrification) and have no connection whatsoever with territorial scale and energy demand. In Europe at least they are being developed at a time when everybody is already connected to the grid and has a good enough kWh at home. The main mode of development of recent renewable energy projects through (nonlocal) private developers and their embedding into market coordination through feed-in tariffs tend to disconnect them from local investment and local consumption (in most cases, the electricity they produce is fed into the grid). This approach allocates benefits (to outside developers) and impacts (to local inhabitants, to the local or national electricity grid) in a specific way that contributes to the frequent perception of these new energy technologies by local people as something alien and divorced from their territory that fails to bring the expected benefits that could compensate for its negative impact. This approach, which is the result of a clear political choice, causes tensions to arise. Local communities feel themselves excluded from the construction of these new modes of producing energy, if not from the decision-making process itself. This seemingly imposed character of many renewable energy projects and the perception of them as being an unfair method of exploiting local resources manifest themselves in various forms of dispute, most typically between the 'winners', who took advantage of this approach to renewable energy and development (electricity companies, some city councils, landowners), and the others.

1.7.2.1 Wind Power Landscapes

Wind power is part of most scenarios depicting our energy future, both on a national and international scale (Chap. 3 by Baraja-Rodríguez et al. in this volume, Warren et al. 2012). It is in some ways a highly symbolic mode of power production, as it was the first of the so-called 'soft' energy technologies to become industrialised and grow in scale. However, the ambiguities of this for-the-first-time-capitalist renewable energy technology have compromised this 'soft' alternative (Evard 2013). In some southern European regions, affected by the gradual decline of local industries and agriculture, the continued afforestation of agricultural land and the decline in rural population, wind power has sometimes been associated with modernity (Chap. 10 by Afonso and Mendes in this volume), as was hydropower at the turn of the nineteenth century. Yet wind power, by virtue of scale, has also been the first decentralised 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). Last but not least, wind power has been the first energy technology to materialise a new political and economic order in rural Europe: the increasing liberalisation of the electricity market and sector. Therefore, many aspects of wind power development made it a testing ground for our capacity to decentralise landscape and energy governance (Chap. 5 by Labussière and Nadaï in this volume, Warren et al. 2012). Difficulties in siting and developing wind power projects and issues of social acceptance must therefore be analysed in a broader context.

1.7.2.2 Solar Power Landscapes

During the first decade of this century, solar power, especially ground-mounted photovoltaic solar power, made the leap from small- to large-scale development. System and module sizes, investments and incentives and their impacts on territory and landscape all multiplied during this period. The development of the photovoltaic market has also led to the creation of a new industrial sector, which at its peak employed around 60,000 people in Spain (Chap. 4 by Mérida-Rodríguez et al. in this volume), and the proliferation of large renewable energy plants/power stations. This process was aided by the feed-in tariff model of incentives, considered to be the most successful instrument for stimulating demand in solar PV power development. The initial feed-in tariffs were so attractive that they soon proved difficult to control and became too expensive. Since 2008, the onset of the economic crisis and the growing international competition between PV panel manufacturers led leading countries, such as Spain and Germany, to reduce their financial support to solar (feed-in tariffs), causing an abrupt slowdown in the spread of solar power projects across Europe.

Although the medium-sized and large ground-mounted solar PV plants 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. 2009, Chap. 13 by Iranzo-García et al., Chap. 14 by Mérida-Rodríguez et al. and Chap. 4 by Mérida-Rodríguez et al. in this volume), they also have some specific features that are worthy of analysis. Unlike wind farms, which are compatible with other types of land use, solar PV ground-mounted plants and thermoelectric plants are not compatible. When they are sited in previously cultivated areas, they lead to 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 have come to consider electricity production in these plants as competing with that of food production, establishing comparisons with the growing of energy crops (Bluemling et al. 2013; Chiabrando et al. 2009) and classifying both kinds of energy as agro-energy (Chap. 6 by Ferrario and Reho in this volume).

The degree to which solar PV systems bring about land-use changes is enhanced by relatively low power of the photovoltaic cells. Solar PV power systems therefore tend to be quite large, and their environmental, territorial and landscape impacts basically depend on the size of the installation and the type of technology used (Chiabrando et al. 2009). As a consequence of the sudden spread of solar PV plants across the territory, particularly the large ground-mounted plants that are usually installed in agricultural areas, regional (e.g. Catalonia in Spain or Sardinia in Italy) and local governments and residential communities in southern Europe have tried to respond to potential problems regarding the siting of these systems by establishing guidelines for the identification of their impacts on land and landscapes or by improving landscape assessment (Chiabrando et al. 2009; de la Hoz et al. 2013).

The Spanish case studies presented in this volume (Chap. 13 by Iranzo-García et al., Chap. 14 by Mérida-Rodríguez et al. and Chap. 4 by Mérida-Rodríguez et al.) and a number of previous studies in Spain (Prados 2010; De Lucas 2007) and in

Greece (Kaldellis et al. 2013; Kontogianni et al. 2013; Tsantopoulus et al. 2014) show growing knowledge amongst local residents of solar PV and thermoelectric farms and their increasing acceptance. Opposition appears when areas are perceived to have reached saturation point or in response to their visual impact or their possible harmful consequences for health or the environment (Chap. 13 by Iranzo-García et al. in this volume).

1.7.2.3 Bioenergy Landscapes

Bioenergy landscapes are a special case. Bioenergy production is increasing in the EU, and it is estimated that the contribution of biogas to natural gas consumption will reach 10 % in 2020 (van Foreest 2012). In Italy alone, the number of biogas plants has grown dramatically from 10 to about 1,100 between 2012 and 2013, due to a favourable policy with a system of obligations and incentives (Carrosio 2013). As in the case of the various forms of solar energy, bioenergies induce direct land-use changes, with the important difference that the deployment of the latter also induces indirect land-use changes when biofuel production converts pre-existing agricultural activity into new often more intensified forms of agricultural production (Palmer 2014). In both cases, bioenergy transforms pre-existing agricultural landscapes and their related social practices, although this transformation is much more evident in the former than in the latter. Moreover, bioenergies are 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 (Bluemling et al. 2013). In addition, outputs from animal waste are composed of more than just energy and require additional actors and related structures to generate value (idem: 12). Biogas therefore tends to be produced on a large industrial scale, which in some cases leads to its decoupling from the local community, as happens, for example, in Italy (Bluemling 2013; Carrosio 2013, Chap. 6 by Ferrario and Reho in this volume). The lack of integration of the policies regulating the development of biogas plants along with other more global issues, such as competition between energy and food production (for land and water), environmental degradation (through GHG emissions, soil and water resource degradation, biodiversity loss, etc.) and its social consequences (through land rights infringements, local and regional food security impacts, etc.), raised doubts about the authenticity of their environmental and socioeconomic credentials (Palmer 2014). In addition, perceived unfairness in the distribution of benefits and disadvantages along the renewable energy production chain has resulted in opposition to biogas plants from local communities (Magnani 2012; Carrosio 2013, Chap. 6 by Ferrario and Reho in this volume).

In spite of the fact that hydro and wind power have been in the vanguard of the current energy transition and that landscape value has been commonly accepted as the most salient public concern when weighing up their costs and benefits, the case studies presented in this book show that issues arising from landscape practices and values are also important and must be addressed for all kinds of renewables. They also demonstrate that the analysis of the various pathways of transition to renewable energy requires a broader knowledge of this question.

1.8 Contents of the Book

The book has five parts covering the following areas: (1) conceptualisation of renewable energy landscapes, (2) development of new energies and emerging landscapes, (3) hydropower and mountain landscapes, (4) renewable energies and protected landscapes and (5) renewable energy landscape planning tools and their application.

Parts I, II and V explore general approaches through different national and regional case studies.

Part I seeks to explain why working at the crossroads between energy and landscape allows us to develop a special insight into the issues and processes arising from the ongoing energy transition. Chapters 1 and 2 discuss the transnational issues arising from the case studies. Chapter 1 (Frolova, Prados and Nadaï) deals with issues at the crossroads between landscape and energy. It also assesses the differences and/or similarities in the case studies, policy, landscape culture and institutional contexts uncovered in the various contributions to this book in order to compare their results. In Chap. 2, Alain Nadaï and Maria-José Prados discuss the way in which cross-national comparison could be approached. They assume that 'energy landscapes' emerge at the crossroads between energy technology development and changes in current landscapes, and they discuss different frameworks for approaching technology development and landscape change. They critically review the recent literature about landscape and renewable energy development. They demonstrate that cross-national comparison of energy landscapes should take into account the particular landscape tradition at work in each country while bearing in mind that the development of renewable energy projects endows these traditions with a renewed existence.

The contributions brought together in Part II show how the development of different kinds of renewable energy has been shaping landscape in different national contexts. They explore this subject by means of a wide range of empirical studies (from Spain, France and Italy) focused on wind, solar PV and thermoelectric power and agro-energies.

Chapters 3 and 4 offer an overview of the deployment of wind and solar photovoltaic energy in Spain. They identify the factors that caused their rise and fall and the consequences of these processes in the landscape. Eugenio Baraja-Rodríguez, Daniel Herrero-Luque and Belén Pérez-Pérez (Chap. 3) show that the deployment of wind energy in different Spanish regions has been heterogeneous, due to their different legislative framework and 'territorial culture'. As the authors point out, 'the only common factors are the limited implementation of regulations regarding landscape and the role of public participation' (p. X). These chapters also analyse the new discourses, social practices and relations produced by wind power, which, with its contradictions and conflicts, has contributed decisively to intensifying the territorial debate and to arousing social awareness of landscape in Spain. M. Mérida-Rodríguez et al. (Chap. 4) review recent studies which address the landscape impact of solar PV infrastructures, suggesting criteria for improving their integration into buildings and landscapes. They also show that the intensity and the speed with which the photovoltaic sector has developed in Spain explain the almost complete absence of coherent regulation of its territorial deployment.

In Chap. 5, Olivier Labussière and Alain Nadaï focus on landscape transformations in France and how they are related with the liberalisation of the energy sector. They argue that wind power development has forced policymakers to confront the issue of decentralising both energy policy and landscape policy in this country. Landscape processes, which take place when wind power is either planned or sited at the local level through open governance, provide occasions for institutional and social innovation that helps pave the way for decentralisation. As such, they argue that wind power is a testing ground for our capacity to decentralise landscape and energy governance, so enabling us to better address the issues that will be raised by other new energy technologies in the near future.

In Chap. 6, Viviana Ferrario and Matelda Reho explore new agro-energy landscapes in the Veneto region of Italy by analysing the regional policies that provide funding for agro-energy development and the landscape transformations they cause. Their study focuses on one of the 'most contested' new agro-energy landscapes in this region, that of biogas. As the authors demonstrate, the social unacceptability of biogas seems to be influenced not so much by its visual impact, but by a lack of policy coordination and the apparent indifference of the public administration to landscape transformations, which generate territorial effects often perceived as unfair.

Parts III and IV focus on specific problems associated with the evolution of the renewable power landscape in southern Europe.

Part III centres on the relationship between hydropower development and mountain landscapes in southern Europe. Many of the mountains in this region were already important hydroelectricity-producing areas by the early twentieth century (e.g. the Alps and the Pyrenees). Other mountain regions were not such important energy producers, but within the favourable framework offered by EU renewable energy policy, new types of energy (such as wind and solar) have been developing in these areas. M. Frolova, Y. Jiménez-Olivencia, M.-Á. Sánchez-del Árbol, A. Requena-Galipienso and B. Pérez-Pérez (Chap. 7); S. Briffaud, E. Heaulmé, V. André-Lamat, B. Davasse and I. Sacareau (Chap. 8); and V. Ferrario and B. Castiglioni (Chap. 9) demonstrate that the process of industrialisation of mountain landscapes in recent decades through the development of 'green' energies is neither new nor more impacting on mountain landscape than earlier industrial developments. These three chapters, defined by their historical approach, offer useful lessons learnt from hydropower development that give us a better insight into today's renewable energy landscapes and their dynamics. Chapters 7 and 8 show that attitudes towards renewable energy infrastructures in Spain and France have often been ambiguous and have fluctuated between acceptance and rejection throughout the twentieth and twenty-first centuries. Finally, as Chap. 9 stresses, local people in the Italian Alps have often been excluded from the decision-making process on hydropower development, and many perceive hydropower production as exploitation of local resources by external actors for external needs, thus giving rise to conflicts and tensions between mountain and plains areas, rural areas and cities, the local population and power companies.

Part IV presents case studies focused on the development of renewables in the mountain regions of southern Europe, territories that occupy large swathes of their respective countries. These areas raise specific issues because most of them, such as natural parks, are protected and include many sites with a high potential for renewable energy development, especially wind power. Specific conflicts and tensions often emerge with the development of new renewable energy sources in these areas.

In Chap. 10, Ana Isabel Afonso and Carlos Mendes analyse from an ethnographic perspective the extent and the ways in which wind power development in communal lands (*baldios*) (Northern Portugal, protected area) empowers (or not) local communities. They show that the embedding of wind power in local politics can work in different directions, providing, for example, an opportunity for local communities to revive long-standing antagonism between rural inhabitants and the conservationist authorities regarding the management of the commons. The top-down approach to nature protection is also revealed in these processes. They also point to the fact that the landscape practices of local communities are the channel through which wind power deployment is gradually embedded into society.

Daniela Perrotti (Chap. 11) focuses her case study on the Puglia region in southern Italy. She analyses the process of PV power development and its consequences for the agricultural lands located inside and outside the perimeters of protected areas. She explores two radically different approaches to the process of planning of energy projects developed for so-called ‘particularly worthy’ landscapes and for ordinary ‘everyday’ landscapes. In so doing, she discusses the green-energy planning process as a potential laboratory for experimenting with a new integrated approach to the spatial planning of energy infrastructures.

In Chap. 12, Michel Deshaies and Daniel Herrero-Luque analyse the driving forces behind wind power development in natural parks in three European countries: Spain, Germany and France. They show that natural parks have to some extent limited the development of wind farms in their territories and that this has occurred in different ways depending on the country under consideration.

Finally, the case studies brought together in Part V deal with renewable energy landscape planning and propose a range of tools for landscape assessment. All three case studies in this part of the book concern Spain. Carles de Andrés-Ruiz, Emilio Iranzo-García and Cayetano Espejo-Marín (Chap. 13) address the solar thermoelectric power landscape in Spain as a new kind of renewable energy landscape and propose a series of criteria that must be taken into account in order to ensure effective territorial and landscape planning of thermoelectric solar energy. Matías Mérida-Rodríguez, Rafael Lobón-Martín and María-Jesús Perles-Roselló analyse landscape features of solar photovoltaic infrastructures and their landscape impacts and offer various landscape integration proposals. Pilar Díaz-Cuevas and Javier Domínguez-Bravo show that GIS is an important tool for the identification of suitable areas for the installation of wind power plants and propose a conceptual framework for establishing the contents and criteria that must be taken into account in each location model. They also make clear that GIS is not a planning panacea and that it is important to be aware of its limitations. All three contributions demonstrate that the process of landscape assessment used in Spain, whatever the method used or the type of renewable energy, is still based heavily on expert opinions. The views of local people are only now beginning to be heard in landscape assessment procedures and with difficulty.

1.9 Challenges Ahead

Renewable energy landscapes have become an essential element of the scenery of southern Europe today and should be treated as such. Protecting all emblematic landscapes from all forms of renewable energy development is not possible, nor is it a necessary or legitimate goal.

In fact, many protected landscapes already house renewable energy projects, and it would be wrong to claim that they always arouse opposition and controversy. In places where they do, this opposition demonstrates the contested nature of the political construction of environmental and landscape protection.

The case studies we have performed in the various countries on different types of renewable energy reveal some of the issues and challenges ahead, especially regarding the way landscape protection may evolve to take renewable energy development into account.

By placing the historical analysis of hydropower development in several regions alongside the analysis of the development of contemporary energy projects, involving, for example, wind energy or solar power, we have highlighted important differences. Due to their current embedding in market visions and economic rationale, contemporary renewable energy projects seem less in sync with State action, public interest and local economic development. The comparison also offers an insight into the dynamics of landscape formation in both cases. It suggests that part of the reason why historical energy infrastructures such as hydropower systems are nowadays considered as heritage landscapes is their multi-scalar embedding in the pre-existing local landscapes.

While it would seem difficult in the short run to reconsider our contemporary broad political inclination towards technology and market coordination, several chapters in this book suggest that there are variables – such as scalar integration or benefit sharing – that could be acted upon in order to improve the ways in which renewable energy projects could be integrated into future energy landscapes.

As regards scalar integration, several chapters in this book point to possible ways of addressing the material aspects of renewable energy devices (size, colour, display) and their siting, which in turn requires a broader reconsideration of the often nationally based practices of landscape protection.

Some of the authors contributing to this book address an even more radical challenge, by calling for a reappraisal of the dominant engineering approach to energy that treats it as a quantifiable output, capacity and commodity. Such techno-economic notions and language separate energy from its flux, dynamics and relational dimension. The stories of the different renewable energy projects and planning experiences presented in this book point to differences in the materiality and in the relationality of renewable energies. Another concept of energy may allow for a better appraisal of this relational dimension and of the varying ways in which renewable energy projects may cohabit with existing land uses or displace them.

Last but not least, this book shows that the principles underpinning landscape protection are more or less centralised, more or less visual, depending on the countries under consideration. Renewable energy development processes often provide opportunities for arousing social awareness of landscape (as they did in Spain) and for evolving these practices at a local level. Several case studies show that even in countries where protection is traditionally targeted at scenic landscapes, the existence of local communities and groups is decisive when it comes to channelling the integration of renewable energy projects.

These findings suggest the need to open the governance of landscape protection. Landscape should be integrated into territorial planning of energy as a transversal element, rather than having a separate sector-based policy, as happens in several countries. Landscape should not be considered as a fixed immutable domain that must be protected from all change. It should rather be approached as a social process, a realm that evolves within a framework of justice and democracy, in order to promote the integration of renewable energy projects as part of local territory. Until recently, landscape planning processes were often the domain of an elite group who designed landscape according to their own particular values. New forms of expertise are required, more geared towards the enabling of participation, in order to extend the reach and the boundaries of social participation. Landscape goes far beyond aesthetics and visibility. It reflects emotional, economic and other relations of local populations with their place. These dimensions should be taken on board in the planning and development of contemporary renewable energy projects.

References

Aitken M (2010a) Why we still don't understand the social aspects of wind power: a critique of key assumptions within the literature. Energy Policy 38(4):1834–1841

Aitken M (2010b) A three-dimensional view of public participation in Scottish land-use planning: empowerment or social control? Plan Theory 9(3):248–264

Aitken M, McDonald S, Strachan P (2008) Locating 'power' in wind power planning processes: the (not so) influential role of local objectors. J Environ Plan Manag 51(6):777–799

Bender B (1998) Stonehenge: making space. Berg, Oxford

Bluemling B (2013) Synopsis of the special issue: 'The social organization of agricultural biogas production and use'. Energy Policy 63:52–54

Bluemling B, Mol APJ, Tu Q (2013) The social organization of agricultural biogas production and use. Energy Policy 63:10–17

Bolinger MA (2005) Making European-style community wind power development work in the US. Renew Sustain Energy Rev 9:556–575
Bouneau C, Varashin D (2012) Introduction. In: Bouneau C, Varashin D, Laborie L, Viguié R, Bouvier Y (eds) Les paysages de l'électricité. Perspectives historiques et enjeux contemporains (XIXe-XXIe siècles). PIE Peter Lang, Bruxelles, pp 9–20
Bouneau C, Varashin D, Laborie L, Viguié R, Bouvier Y (eds) (2012) Les paysages de l'électricité. Perspectives historiques et enjeux contemporains (XIXe-XXIe siècles). PIE Peter Lang, Bruxelles
Brunet R (1995) Analyse des paysages et semiologie. In: Roger A (ed) La téorie de paysage en France (1974-1994). Champ Vallon, Seyssel, pp 7–20
Carriveau R (ed) (2012) Advances in wind power. InTech Publisher, Rijeka
Carrosio G (2013) Energy production from biogas in the Italian countryside: policies and organizational models. Energy Policy 63:3–9
Chiabrando R, Fabrizio E, Garnero G (2009) The territorial and landscape impacts of photovoltaic systems: definition of impacts and assessment of the glare risk. Renew Sustain Energy Rev 13(9):2441–2451
Claval P (2011) In Lieu of conclusion: changing scope and ambitions in landscape concerns. In: Roca Z, Claval P, Agnew J (eds) Landscapes, identities, and development. Ashgate, Farnham, pp 461–475
Council of Europe (2000) European landscape convention. STE, 176 http://conventions.coe.int/Treaty. Accessed 1 Mar 2014
Cowell R (2009) Wind power, landscape and strategic, spatial planning-the construction of 'acceptable locations' in Wales. Land Use Policy 26(3):222–232
de la Hoz J, Martín H, Martins B, Matas J, Miret J (2013) Evaluating the impact of the administrative procedure and the landscape policy on grid connected PV systems (GCPVS) on-floor in Spain in the period 2004-2008: to which extent a limiting factor? Energy Policy 63:147–167
De Lucas M (2007) Aves y parques eólicos: efectos e interacciones. Consejo Superior de Investigaciones Científicas y Universidad Autónoma de Madrid, Madrid
Devine-Wright P, Devine-Wight H (2006) Social representations of intermittency and the shaping of public support for wind energy in the UK. Int J Glob Energy Issues 25(3/4):243–256
Devine-Wright P (ed) (2011) Renewable energy and the public. From NIMBY to participation. Earthscan Publisher, London/Washington
Ellis G, Barry J, Clive R (2007) Many ways to say 'no', different ways to say 'yes': applying Q-methodology to understand public acceptance of wind farm proposals. J Environ Plann Manag 50(4):517–551
Ellis G, Cowell R, Warren C, Strachan P, Szarka J (2009) Expanding wind power: a problem of planning, or of perception? Plan Theory Pract 10(4):523–532
EU (2001) Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 COM 2001/77/EC, Brussels
Evard A (2013) Contre vents et marées: Politiques des énergies renouvelables en Europe. Presses de Sciences Po, Paris
Frolova M (2010) Landscapes, water policy and the evolution of discourses on hydropower in Spain. Landsc Res 35(2):235–257
Frolova M, Pérez Pérez B (2011) New landscape concerns in the development of renewable energy. Projects in South-West Spain. In: Roca Z, Claval P, Agnew J (eds) Landscapes, identities and development. Ashgate, Farnham, pp 389–401
Frolova M, Menor Toribio J, Cancer Pomar L (2003) El paisaje en las políticas públicas de Francia y España: desde la protección del monumento a la gestión del espacio. Estudios Geográficos LXIV(253):605–622
Frolova Ignatieva M, Espejo Marín C, Baraja Rodríguez E, Prados Velasco MJ (2014) Paisajes emergentes de las energías renovables en España. Boletín Asociación Geógrafos Españoles 66:223–252
Gee K (2010) Offshore wind power development as affected by seascape values on the German North Sea coast. Land Use Policy 27(2):185–194
Gross C (2007) Community perspectives of wind energy in Australia: the application of a justice and community fairness framework to increase social acceptance. Energy Policy 35(5):2727–2736

Hagget C, Toke D (2006) Crossing the great divide – using multi-method analysis to understand opposition to windfarms. Public Adm 84(1):103–120

Iglesias G, del Río P, Dopico JA (2011) Policy analysis of authorization procedures for wind energy deployment in Spain. Energy Policy 39:4067–4076

Kaldellis JK, Kapsali M, Kaldelli EL, Katsanou EV (2013) Comparing recent views of public attitude on wind energy, photovoltaic and small hydro applications. Renew Energy 52:197–208

Kontogianni A, Tourkolias CH, Skourtos M (2013) Renewable portfolio, individual preferences and social values towards RES technologies. Energy Policy 55:467–476

Labussière O, Nadaï A (2014) Unexpected wind power 'potentials': the art of planning with inherited socio-geographical configurations (France). Scottish Geogr J. doi:10.1080/14702541.2014.922210

Magnani N (2012) Exploring the local sustainability of a green economy in Alpine communities. A case study of conflict on biogas plant. Mt Res Dev 32(2):109–116

Martinet J (1983) Le paysage: signifiant et signifié. In: Lire le paysage, lire les paysages. CIEREC, Saint-Étienne, pp 61–68

Meyer NI (2007) Learning from wind energy policy in the EU: lessons from Denmark, Sweden and Spain. Eur Environ 17(5):347–362

Möller B (2010) Spatial analyses of emerging and fading wind energy landscapes in Denmark. Land Use Policy 26(3):233–241

Moore S (2013) Envisioning the social and political dynamics of energy transitions: sustainable energy for the Mediterranean region. Sci Cult 22(2):181–188

Nadaï A (2012) Planning with the missing masses: innovative wind power planning in France. In: Szarka J, Cowell R, Ellis G, Strachan P, Warren C (eds) Learning from wind power: governance, societal and policy perspectives on sustainable energy. Basingstoke, Hampshire (UK). doi:10.1057/9781137265272

Nadaï A, Labussière O (2009) Wind power planning in France (Aveyron): from State regulation to local experimentation. Land Use Policy 26(3):744–754. doi:10.1016/j.landusepol.2009.10.011, http://www.sciencedirect.com/science/article/pii/S0264837708001208

Nadaï A, Labussière O (2010) Birds, turbines and the making of wind power landscape in South France (Aude). Landsc Res 35(2):209–233. doi:10.1080/01426390903557964

Nadaï A, Labussière O (2012) Le paysage éolien, décentralisation énergétique et paysagère. In: Bouneau C, Varaschin D, Laborie L, Viguié R, Bouvier Y (eds) Paysages de l'électricité: perspectives historiques et enjeux contemporains (XIXe-XXIe siècles) Coll. Histoire de l'énergie. Peter Lang, Bruxelles, pp 185–202

Nadaï A, Labussière O (2013) Playing with the line, channelling multiplicity – wind power planning in the Narbonnaise (Aude, France). Environ Plan D 31(1):116–139. doi:10.1068/d22610

Nadaï A, Labussière O (forthcoming) Communs paysagers et devenirs éoliens opposés: Le cas de la Seine-et-Marne (France). Projet de Paysage

Nadaï A, van der Horst D (2010) Introduction: landscapes of energies. Landsc Res 35(2):235–257

Nadaï A, Krauss W, Afonso AI, Dracklé D, Hinkelbein O, Labussière O, Mendes C (forthcoming) A comparison of the emergence of wind energy landscapes in France, Germany and Portugal. In: Terrasson D, Luginbuhl Y (eds) Landscape and sustainable development. Ashgate, London

Oles T, Hammarlund K (2011) The European landscape convention, wind power, and the limits of the local: notes from Italy and Sweden. Landsc Res 36(4):471–485

Olwig K (2002) Landscape, nature, and the body politic. The University of Wisconsin Press, Madison

Olwig K (2007) The practice of landscape 'conventions' and the just landscape: the case of the European landscape convention. Landsc Res 32(5):579–594

Ottinger Q (2013) The wind of change: environmental justice in energy transitions. Sci Cult 22(2):222–229

Palmer JR (2014) Biofuels and the politics of land-use change: tracing the interactions of discourse and place in European policy making. Environ Plan A 46:337–352

Pasqualetti MJ (2011) Opposing wind energy landscapes: a search for common cause. Ann Assoc Am Geogr 101:907–917

Pasqualetti MJ, Gipe P, Righter RW (eds) (2002) Wind power in view: energy landscapes in a crowded world. Academic, San Diego
Pitte JR (1983) Histoire du paysage français. Tallandier, Paris
Prados MJ (2010) Renewable energy policy and landscape management in Andalusia, Spain: the facts. Energy Policy 38(11):6900–6909
Selman P (2010) Learning to love the landscapes of carbon-neutrality. Landsc Res 35(2):157–171
Smith A (2007) Emerging in between: the multi-level governance of renewable energy in the English regions. Energy Policy 35:6266–6280
Söderholm P, Ek K, Pettersson M (2007) Wind power development in Sweden: global policies and local obstacles. Renew Sustain Energy Rev 11:365–400
Strachan P, Lal D, Toke D (2009) Wind power and power politics: international perspectives. Routledge, New York
Stremke S, van den Dobbeisteen A (eds) (2012) Sustainable energy landscapes: designing, planning and development. CRC Press, Boca Raton
Szarka J (2007) Wind power in Europe: politics, business and society. Palgrave Macmillan, Basingstoke
Szarka J, Cowell R, Ellis G, Strachan P, Warren CH (eds) (2012) Learning from wind power: governance, societal and policy perspectives on sustainable energy. Palgrave Macmillan, Basingstoke
Toke D, Breukers S, Wolsink M (2008) Wind power deployment outcomes: how can we account for the difference? Renew Sustain Energy Rev 12:1129–1147
Torres-Sibille AC, Cloquell-Ballester VA, Artacho Ramírez MA (2009) Aesthetic impact assessment of solar power plants: an objective and a subjective approach. Renew Sustain Energy Rev 13:986–999
Tsantopoulus G, Arabatzis G, Tampakis S (2014) Public attitudes towards photovoltaic developments: case study from Greece. Energy Policy 71:94–106
Tsoutsos T, Frantzeskaki N, Gekas V (2005) Environmental impacts from the solar energy technologies. Energy Policy 33:289–296
UE (2014) A policy framework for climate and energy in the period from 2020 to 2030 COM 2014(15) final, January 22, Commission of the European Union, Brussels, January 22
van der Host D, Lozada-Ellison LM (2010) Conflictos entre las energías renovables y el paisaje: siete mitos y la propuesta de manejo adaptativo y colaborativo. Nimbus. Revista de Climatología, Meteorología y Paisaje 25/26:231–251
van Foreest F (2012) Perspectives for biogas in Europe. University of Oxford, Oxford Institute for Energy Studies. Working paper NG70. http://www.oxfordenergy.org/wpcms/wp-content/uploads/2012/12/NG-70.pdf. Accessed 10 Apr 2014
Varaschin D, Bouvier Y (2009) L'électricité, diva à Divonne. In: Varaschin D, Bouvier Y (eds) Le patrimoine industriel de l'électricité et de l'hydroélectricité, Actes du colloque international de Divonne-les-Bains et de Genève. Université de Savoie, Chambéry, pp 7–12
Warren C, Cowell R, Ellis G, Strachan PA, Szarka J (2012) Wind power: towards a sustainable energy future? In: Szarka J, Cowell R, Ellis G, Strachan P, Warren C (eds) Learning from wind power: governance, societal and policy perspectives on sustainable energy, Energy, climate, and the environment series. Palgrave MacMillan, New York, pp 1–14
Wolsink M (2007) Planning of renewables schemes: deliberative and fair decision-making on landscape issues instead of reproachful accusations of non-cooperation. Energy Policy 35(5):2692–2704
Wolsink M (2010) Near-shore wind power—protected seascapes, environmentalists' attitudes, and the technocratic planning perspective. Land Use Policy 27(2):195–203
Woods M (2003) Conflicting environmental visions of the rural; windfarm development in mid-wales. Sociol Rural 43(3):271–288

Chapter 2
Landscapes of Energies, a Perspective on the Energy Transition

Alain Nadaï and María-José Prados

Abstract This chapter discusses the way in which cross-national comparison shall be approached. We assume that energy landscapes emerge at the crossroad of RE technology development and changes in current landscapes. We successively discuss different frameworks for approaching technology development and landscape change, before turning to the recent literature about landscape and renewable energy development. We conclude that cross-national comparison of landscapes of energies should be attentive to the type of landscape tradition at work in each country and account for the fact that the development of renewable energy endows these traditions with a renewed existence. Depending on the extent and the focus of the conflicts or controversies raised around RE projects, the method and focus of the analysis shall differ.

Keywords Landscape • Renewable energy • Process • Planning • Technology

2.1 Introduction

The ongoing changes in our energy mix are part of what is nowadays termed the "energy transition." The term points at a process that goes beyond a mere quantitative change in this mix and a mere diversification of our energy sources. It reaches to a change in our ways of consuming energy, our ways of relating with the spaces required for producing, transforming, and transporting these new energies. As Nadaï and van der Horst (2010) have pointed at, these changes trigger a new interest in the landscape-energy relationship. Renewable energy is widely and unevenly

A. Nadaï (✉)
CIRED-CNRS (Centre International de Recherche sur l'Environnement et le Développement), 45 bis, avenue de la Belle Gabrielle, F-94736 Nogent-sur-Marne CEDEX, France
e-mail: nadai@centre-cired.fr

M.-J. Prados
University of Sevilla, María de Padilla s/n, 41004 Sevilla, Spain
e-mail: mjprados@us.es

M. Frolova et al. (eds.), *Renewable Energies and European Landscapes*,
DOI 10.1007/978-94-017-9843-3_2

dispersed across the land, the extent to which it can be accessed and harnessed is to an important extent dependent on landscape.

Landscape has a multiple existence. It is a material and spatial entity. Specific physical landscape characteristics may be much more prevalent in some areas than in others; they may or may not allow access to energy resources. However, this access is itself a construction. Landscape, as a shared way of conceiving, experiencing, and practicing our territories, is part of the manner in which we are to construct this access. For instance, recent analyses show that, in many countries, wind power development challenges the ways in which people relate to their landscapes. Sometimes, this development raises genuine controversies. In such cases, usual patterns of deciding, qualifying, and regulating landscapes, usual benchmarks for arbitrating which renewable energy developments shall be authorized and which developments shall not, become the problem rather than the solution. To a certain extent, comparing energy landscape in different countries points at this issue: as energy landscapes are emerging, we oftentimes do not know whether we shall or can appreciate them or not. As Paul Selman recently phrased it, we do not know whether we could (or should) "learn to love" these new landscapes (Selman 2010).

This chapter aims at discussing the way in which cross-national comparison shall be approached. We assume that energy landscapes emerge at the crossroad of energy technology development and changes in current landscapes: the spatial impact of RE technology can be regarded as a recomposition of socio-technical links between landscape and energy. Thus, we successively discuss different frameworks for approaching technology development (Sect. 2.2), on the one hand, and landscape change (Sect. 2.3), on the other hand. We discuss the state of the literature (Sect. 2.3) as regards to this issue, trying to point at the analyses which do account for the various dimensions involved in the processes of emergence of energy landscape, notably: energy, planning, and landscape. Finally, we try to sort out approaches which might allow us to trace and describe processes of emergence from approaches that do not (Sect. 2.4). The former have a potential for tracing and describing the emergence of energy landscapes.

2.2 Evolving Our Energy Mix

2.2.1 Energy Transition and Societal Change

Changing energy mix is to some extent akin to changing technologies. The relation between technology and the social dimension has been a subject of interest for social sciences since a long time. Notably, the debate has revolved around "social vs. technological" determinism: Does a technology impose a given political order or does the social shape what a technology becomes (Winner 1980)? The 1960s and 1970s have been a period for revival of these issues in social sciences.

In the 1970s, evolutionary economics started exploring the evolution of technological objects over long periods of time (Dosi 1982; Nelson and Winter 1977, 1982).

These analyses emphasized the role of path dependency and socio-institutional lock-in in technological developments. Technologies have progressively been envisioned as socio-technical systems, made up of mutually dependent set of practices, skills, technologies, infrastructures, coalitions of actors, and institutions (e.g., energy lobbies, rules, standards, ways of defining and framing problems, etc.) (Nelson and Winter 1982; Arthur 1989). So for energy systems (Grübler et al. 1999; Unruh 2000): they are not value-free. Actors, institutions, and even the structure of the economy end up depending to some degree on the existing technological pathways. These reasons explain why changes of system take time, and it is systemic change rather than linear. While all levels of government (from local through to international) can and should play an important role in encouraging renewable energy development through policies, other actors are also important.

The capacity of institutions to learn from the involvement of various sections of society in policy development becomes a key factor for policy success. Yet, beyond this somewhat consensual statement, one can distinguish between two types of approaches. Some approaches focus on technology and technological change as a *system*, while other approaches focus on technology and technological change as a *process*.

2.2.2 Technology as a System

The idea that technology is a system has been followed up during the 1980s and 1990s by analysts of innovation systems (IS), technical innovation systems (North 1990; Carlsson and Stankiewicz 1991; Geels 2002; Schot and Geels 2008; Suurs 2009), and national innovation systems (Lundvall 1992; Nelson 1993; Foray and Freeman 1992). A key assumption behind IS approach is that determinants of technological change are not only located in individual firms or in research institutes but also in a broader societal structure in which firms as well as knowledge institutes are embedded. IS studies have pointed out the influence of such social structures on technological change and economic growth. The IS approach tends to stress the relations between actors and institutions. The notion of system implies a holistic perspective whereby the resultant of the system is not a linear function of its elements, but the product of numerous relations between its elements. Thus, technological change is seen as a complex outcome (determined by the weakest element in the system). While IS approaches are various, they more or less share the assumption that actors, as entities, preexist to the system: they can come or go, contribute or not to structures or functions, but the process of them emerging and becoming entities is not part of the analysis. As Suurs states it:

> "On a higher level, all the structural factors combined may be considered to form one big network that, provided that it is a more or less coherent whole, constitutes a system configuration. One may also speak of a seamless web (Hughes 1986); however, the idea of a seamless web does not help the analyst very much. It will be more useful to apply a perspective that binds elements together and summarizes them, in analytical terms, on the system level (Suurs 2009: 48)".

The notion of "seamless web" points to the facts that the making of entities, which can be traced when entities are in the making, is no longer decipherable when entities have emerged. Seams have healed and the whole cannot point back to the contributions of parts in its own making. So the notion of "seamless web", despite disqualified by Suurs, is interesting in that it draws attention to processes of emergence. It points to the fact that entities or agents which have been active in the emergence of a system are not necessarily the ones you can "summarize […] in analytical terms" by looking at a system. In loosing this process thinking, system approaches tend to reduce the role of social interactions to a "factor" influencing (often hampering) technological change: these approaches cannot thus account for the propensity of technology and society to enter in joint composition in a constructive manner.

2.2.3 Technology as a Process

What we might call here, for the sake of clarity, "process approaches" are approaches that are in line with the notion of seamless web, as proposed by Hughes (1986). According to this perspective, a technology reconfigures its environment in order to emerge. As Madeleine Akrich has described it (Akrich 1989), humans and nonhumans can contribute to this process. Actors and practices are realigned in relation with the technology. This process of co-evolution of the technology and its environment, that allows the technology to become an "efficient" technology, is then erased. Reification, as Akrich terms it, is the process through which this newly composed environment is then considered and advocated as a state of nature, in order to justify the choice of the emergent technology as the most efficient one (given the current state of affairs). The seamless web results from these process and work of reification. Akrich's analysis of the emergence of tobacco stamps as a new source of energy in Nicaragua puts the emphasis on the process of emergence—changes in entities, actors, relations, and practices—of what she terms a "socio-technical system."

Examples of such processes are numerous in the field of renewable energy technologies. For instance, the emergence of renewable energy technology in the European Union since the 1990s has been accompanied by the emergence of actors and organizations (e.g., European Renewable Energy Council (EREC), European Wind Energy Association (EWEA), etc.), which are "global." These actors are connected largely and influential as regards to the course and evolution of renewable energy policies, notably because they devise and propose visions and scenarios about the future of EU energy system. Certain networks of local actors (e.g., Energy Cities, International Council for Local Environmental Initiatives (ICLEI), etc.) have also gained connection with the European institutions. In cases such as the setting up of the Convention of Mayors, they even contributed in steering EU action and financing in the field of climate energy policy. So, "scales"—in the sense of which actors or entities are largely connected and/or influential or not—have been emerging in the field of climate energy issues over the past 20 years.

The process of emergence of renewable energy socio-technical systems is also changing the ways in which landscapes are being connected locally or globally. In most EU countries, the development of wind power has been underpinned by the liberalization of the electricity market, which made it possible for new energy producers to enter the electricity sector. In countries such as France, the development of wind power, which was based on feed-in tariffs granted to private wind power developers and colonized the rural space, was oftentimes perceived as the end of public policy. Instead of being faced with Electricité de France (EDF)—the former national electricity provider—asking for access to the rural space on the grounds of public interest, local mayors and farmers are now faced with private actors proposing private rents to individuals, in exchange of plots of lands for wind farms development. In so doing, the local or national governance which in many places underpinned a longstanding articulation between place, space, and landscape became rearticulated with a supranational process. The vectors of this rearticulation are the wind power projects, because they are locally sited but they are conceived, designed, and developed in relation with national and transnational processes, actors, and networks. So, in some ways, the "places" of our landscapes, in the sense of the web of relations which underlay these landscapes, become reconfigured in this process: climate change, climate energy policies, and the liberalization of the electricity sector have become part of the making of landscape.

The material scale of wind turbines and their standardization as artifacts aligned with an industrial referential – characterized by cost reduction and economies of scales in production, increased size, and productivity in harnessing the wind – also impose new dimensions, scales, and visual relations in the landscape. As shown by many case studies in France (Nadaï and Labussière 2013, 2015) (also Chap. 5 by Labussière and Nadaï in this book), this has lead to changes in the ways in which institutions and local collectives' experience represent and regulate landscape relations through local planning processes or national policy frameworks. These issues and changes have been shown to differ depending on the country under consideration, leading to different degrees of synergies or conflicts in wind power development (Nadaï et al. 2010, 2013 and Sect. 2.5 below). These few illustrations show that looking at the energy transition through the lens of landscape might contribute in deepening the analysis of how renewable energy technologies might, through their development, recompose entities and relations.

2.3 A Missing Link

The current literature about renewable energy policy, planning, and landscape reflects the difficulties in assessing the different dimensions of newly emerging renewable energy landscapes. A conflict has arisen between, on the one hand, the general acceptance of these forms of energy as a solution to the big environmental challenges facing the modern world and, on the other, the rejection of the changes wrought by large renewable energy infrastructures on cultural landscapes of great value. Once we relinquish the traditional concept of landscape as an aesthetic backdrop for the collective memory, landscape management can become part of spatial planning and by extension of the energy policy decision-making process. When it reaches this stage, landscape is no longer considered a fragile entity vulnerable to the changes brought about by infrastructures, in some cases oversized, and in others that clash with the concept of landscape as a cultural construction. Analyses of the potential damage caused to landscape by the divorce between energy planning and spatial planning are present in numerous articles by expert researchers. Some of the most important contributions in this field have appeared in journals such as *Energy Policy*, *Land Use Policy*, *The Annals of the Association of American Geographers*, and *Landscape Research*, providing evidence of this contentious alliance between energy landscape and spatial planning. The first research papers appeared in the 1980s and 1990s and focused on nuclear energy, which at that time was a highly controversial and divisive issue that faced bitter opposition from green groups, a stance that had strong popular support, while winning the general approval of political leaders and electric companies. One of the pioneering authors in this field was Owens, who systematized the various negative characteristics of power stations that should lead governments to control or limit their development: they occupy large areas, they intrude on the landscape, and they are technologically complex and can cause serious, irreversible impacts on the environment (1985: 226). Initially these and other possible problems with renewable energies were considered of minor importance and remained obscured by the growing alarm generated by conventional energy sources. In fact, the green groups offered their unconditional support to new energy sources as an alternative to conventional energy and tipped the political agenda on energy in favor of renewables. However, as more and more projects have appeared and large installations have been erected, public opposition has begun to emerge, and Owens' ideas are now beginning to be taken more seriously, both in terms of the spatial location of energy plants and of energy planning processes. Subsequent research included critical analyses of the local impact of renewable energies (in this case, wind power) and the way wind farms are perceived by the residents of the area in which they are installed, juxtaposing their opinions with those of other population groups who do not live near them. Walker argued that the different points in time when energy plants are installed directly influence the notion of associated impacts, so that today, after years of accumulated experience, people are more aware that they can have undesired consequences (Walker 1995). This author also stated that there were an array of demographic, social, cultural, and economic factors affecting the people who lived near renewable energy plants which tended to lead to the formation of different opinions and assessments. A great deal of research has been done in the USA, on the fast growth in wind power in California in the 1970s (Bosley and Bosley 1990), in Sweden and the Netherlands, on the installation of turbines always in conjunction with a process of public consultation about the perceived impact (Carlman 1986; Wolsink 1988), and lastly in the UK, where a lot of work has been done on the impact of wind farms, especially in coastal areas (Varley et al. 1989). The results of these studies highlight those aspects of wind energy that produced public rejection and those that were well regarded. The identification of these positive and negative factors by academic researchers has created a useful tool when taking decisions about the location of new energy plants in a harmonious relationship with their landscapes and, for the purposes of this book, how research has contributed to the analysis of the problems associated with the spatial configuration of renewable energy installations (Walker 1995).

Indeed, a central theme running through the debate about renewable energy policy, planning, and landscape is undoubtedly that of the analysis of the social perception and acceptance of renewable energies by a sector of the population. The *leitmotiv* is the impact of the installation of renewable energy plans on cultural landscapes (Woods 2003; Haggett and Toke 2006; Devine-Wright and Devine-Wright 2006; Pasqualetti 2011). Wüstenhagen et al. (2007) provided a new vision of renewables, once technological advances had helped them spread and grow, and discussed their capacity to produce new energy landscapes. This time, the most important impacts were systematized first of all by the fact that renewable energies mostly act on resources above ground level making them more visible than certain other energy systems. Secondly, the ubiquity of the resources used in energy production multiplies the number of possible locations. Thirdly, the large installations typically have a low ratio between power production and area occupied, which means that they have a higher visual impact (Wüstenhagen et al. 2007). This low production/territory ratio increases their presence in the landscape, and they acquire a new image as new, visually invasive elements. The defect in these approaches lies in the disassociation between the environmental benefits of using renewable energy compared to other energy sources and the territorial and landscape costs produced by the lack of integral planning of energy policy. There is abundant literature on this question in relation to wind power plants and the technological and environmental problems associated with them (Szarka 2004; Haggett 2008; West et al. 2010). Research has been done on the NIMBY (not in my back yard) principle (van der Horst 2007; Wolsink 2007), on the idea of fairness or justice in the decisions regarding plant installations and the degree of confidence about the absence of risks (Huitjs et al. 2007), and on the development of micro-generation of energy and on cooperation for technological development. Also important are the questionnaires and in-depth interviews that approach the issue from the perspective of environmental psychology (Zoellner et al. 2008) and the role of cultural theory and focus groups in order to understand how individual perspectives combine to form collective opinions and actions regarding the perception of renewable energies (West et al. 2010). This line of approach to the analysis of the social perception and acceptance of renewable energies culminates in two issues of *Landscape Research* and *Land Use Policy* journals (Landscape Research (2010) 35 (2), Land Use Policy (2010) 27). In general, the subject was approached from two perspectives: firstly, that of the interference in and invasion of cultural landscapes by energy plants and secondly, from the point of view of landscape as a living entity that is evolving in a new direction, creating new energy landscapes. There are other noteworthy, more theoretical pieces of research (Selman 2010; Nadaï et al. 2010), and other more empirical investigations of the transformations of energy landscapes with a strong historical or cultural content (Van der Horst and Toke 2010; Frolova 2010) and on the relationship between wind power and protected spaces (Krauss 2010; Nadaï et al. 2010). In the case of *Land Use Policy*, the articles revolve around the relations between population, socioeconomic development, and the value of landscape as formers of opinions and attitudes (Van der Horst and Toke 2010). New aspects of energy governance, territorial energy planning, and the adoption of strategies have also been explored (Cowell 2010).

All of this research leads us to the conclusion that there are two essential conflicts of interests, on the one hand, between developers and local residents and, on the other, between energy policy and spatial planning. If spatial planning and landscape management are not taken into consideration when drafting energy policy, the impact on the landscape will become the central issue in the debate on renewable energies (Nadaï 2007, for France). In spite of generalized support for energy policies based on sustainability criteria, the real situation is that a sector of the population affected by renewable energy installations does notice a decline in their quality of life (Zoellner et al. 2008). Popular rejection of renewable energies is normally provoked by large projects with a great landscape impact that are made with environmentally unfriendly materials and in which the design of the energy system shows no concern for the place where it is to be installed. An additional cause of rejection is that installation normally involves the removal of vegetation and a change in land use (normally away from agricultural use) (Prados 2010a). Small-scale projects on the other hand are generally popular and widely accepted, above all if they are based on proposals that benefit the community and in which local citizens have participated (Bosley and Bosley 1992; Warren and Mcfadyen 2010). When these projects also bring tangible economic benefits (reduction in electricity prices, job creation, or the guarantee that the price of land will be maintained), public opinion is normally very favorable (Pasqualetti et al. 2002; Walker 2007). Attitudes with regard to renewable energies are therefore highly variable, dynamic, and sometimes even contradictory. Interesting parallels can be drawn with coal mining, hydroelectricity, and even oil rigs, which seem to have managed to insert themselves into the territory and to have created new landscapes (Cowell 2010: 229). This is why it is so important to combine energy planning, spatial planning, and landscape management.

All the analysis confirms that in fact quite the opposite is true and that what we actually have are opposing discourses about spatial planning and landscape on one hand and spatial planning and energy policy on the other (Prados 2010b). The impacts relating to location, construction, land use changes, effects on infrastructures, etc., are considered collateral effects of spatial intervention. Little by little, these effects are more clearly perceived by a public opinion that is capable of identifying and assessing the problems associated with the spatial configuration of renewable energy installations. This may help to shape the political agenda regarding energy plants with no spatial planning or consideration toward the landscape. The opinions about the disassociation between renewable energies and landscape revolve around two discursive themes. The most widely extended discourse argues that in order to achieve the implementation of socially accepted renewable energy systems, energy and spatial planning must go hand in hand. In order to achieve this goal, it is important to propose ideal locations not only from the point of view of the availability of the energy resource but also so as to avoid any negative effects on the cultural landscapes. As Zoellner et al. pointed out, we must ensure that preserving the quality of the landscape becomes a factor of reference in the physical insertion of energy plants (Zoellner et al. 2008). Other discourses place greater emphasis on the management of the landscape and the need to establish protection mechanisms. Their ideas focus specifically on defending the landscape against energy plants, especially in countries in which renewable energy landscapes are already widespread. This line of argument was initially dominated by the visual impact of energy infrastructures and the aesthetic vision of the landscape, while in recent times, new ideas about protection, planning, and management of landscapes and even territorial governance have been incorporated into the debate (West et al. 2010). As a final consideration, we can say that landscape is now taken into account as an active entity that has certain qualities (environmental, cultural, and territorial) that must be integrated into planning strategies (Nadaï 2012; Nadaï et al. 2013). The ultimate objective is still, in this case too, that of identifying suitable locations so as to prevent renewable energy installations from contributing to the degradation of the landscape. However, protected landscape and the associated category and procedures of landscape protection can be brought into debate, and recomposed, in these planning processes. Theoretical developments in the field of landscape studies can be very useful in addressing these changes.

2.4 Evolving Our Landscapes

By virtue of their object (landscape),[1] landscape studies have reached a certain maturity in struggling with the complex relations between formal/symbolic/pictorial representations on the one hand and materiality/practices/processes on the other hand. The field traces back to various traditions in the USA and the UK (Sauer 1963; Jackson 1997), all engaged with the physical description of actual landscapes, but also to differing degrees, with their cultural and symbolic dimension (especially in Jackson's case). These traditions of "physical landscape" offered the basis against which new approaches to landscape have later on developed and defined themselves, albeit in very different directions. From the mid-1980s to the mid-1990s, the so-called "visual" approaches to landscape emerged as part of a cultural turn in human geography. Landscape was conceived as a way of seeing and representing the world. It was assimilated into the art of producing and transmitting meaning through visual representations. In a rather structuralist perspective, these approaches focused on visual or symbolic representations as expressions of cultural, political, and economic power (Cosgrove 1998; Cosgrove and Daniels 1998; Duncan and Duncan 1988). They conceived landscape per se as a visual representation (which could be a park or a pictorial image) endowed with an ideological function and a cultural meaning, which was to be understood and uncovered. Since the 1990s, a

[1] What follows is inspired by Nadaï and Van der Horst (2010).

"newer" cultural geography has criticized and somewhat expanded this strand by developing a poststructural perspective. Landscape became part of *multifaceted cultural processes* as both a representation and a *materiality* through which the social, political, cultural, and environmental relations enacted through and within landscape could be reintroduced in the analysis. Anthropological works on landscape as a cultural process are part of this strand (Hirsch and O'Hanlon 1995). So is also Kenneth Olwig's work on the "substantive" landscape, tracing the pre-Renaissance Northern Europe landscape back to a myriad local polities and places (Olwig 1996, 2002) later on unified, with the rise of the Nation State, in an ideological and visual representation (the scenery). Such a perspective allows the analyst to capture the current tensive relations between the bottom-up construction of a European landscape through the practice of "Convention" (the European Landscape Convention) (a type of polity) and the top-down territorial/landscape planning by the states (based on regulations and scenery-type representations) (Olwig 2005, 2007). This evolution is thus contemporary with a change in the way of approaching landscape governance and protection, notably through the development and implementation of the ELC: landscape no longer is restricted to heritage landscapes but also conceived and sometimes approached as a matter of daily perception and practice; landscape while recognized as deemed of protection is no longer supposed to remain untouched and frozen, but protected within a broader perspective that gives way and place to local expressions for becomings and projects. The likely tensions between local politics, territorial dynamics, and the processes of inscription of local landscape as part of our common heritage—such as the UNESCO World Heritage—are subject to an increasing number of analyses (Bonta 2005). Such tensions also emerged in the analyses of the development of ReN projects, as the classification of landscape as UN heritage, when this is the case, oftentimes is used as an argument in the opposition to ReN projects (Jolivet and Heiskanen 2010). Thus, the change in analysis comes along with a change in policy approach at the European, national, and also transnational level through the UN.

The representational approach to landscape has also been challenged by recent works derived from *Hybrid Geographies* (Whatmore 2002).[2] The ensuing shift from topo*graphical* to topo*logical* approaches (Thrift 2000, 2004a, b) emphasizes the process of construction of space/landscape. It challenges the weight of space/landscape representations over human agency by focusing on the process of construction of space/landscape through social relations networks, practices, connective properties, dynamic flows, and vital forces making landscape become what it is (Lorimer 2005; Rose 2002). Bonta's analysis of the conflict between local population and a hydroelectric project in a Honduras neotropical cloud forest area documents such a process (Bonta 2005). The author describes how this protected area fails to evolve into an idealized "conservation space" partly because of migrant agriculture, but undergoes transformations until it becomes accepted by local actors

[2] *Hybrid geographies* emphasize the blurring of the nature-culture divide because of the development of new (bio-) technologies. It subsequently pushes a symmetric agenda questioning the naturalness of space.

as a space that provides protection for marginalized groups under threat to be dislodged by the hydro-project.

Such topological approaches have recently been questioned for their tendency to overlook basic dimensions of our perception (and experience) of landscape, such as shadows, depth, colors, relief, or contours, because these dimensions were considered as being exclusively representational. "Animating landscape" (Rose and Wylie 2006), that is to say overcoming the split between relational and representational approaches, is a current issue in the field. It calls for the development of *nonrepresentational approaches which could account for the emergence and the role of representations in the making of landscape*. A recent attempt to bridge this gap based on a case study related to ReN issue is Nadaï and Labussière (2010, 2013) analysis of a wind power planning process in the southwest of France—the Parc Naturel Régional de la Narbonnaise. The authors describe the way in which the landscape architects in charge of wind power planning develop iconographic devices in order to reflect upon the play of relations—visual, scale, and social—that wind power development might bring about in the local Narbonnaise landscape. The case study points at an approach to landscape planning whereby planners' decisions relate to the site/situation which they aim to transform rather than relying to preexisting norms or abstract territorial representations. It even points at the practical ways in which this approach finds a methodological translation in graphic design and shows how an iconographic practice can contribute in composing an emerging reality (a new landscape) without indexing it to preexisting and normative representations of the territory.

A daring, yet inspiring, parallel could be drawn between the couple of opposite approaches we just mentioned: system vs. process approach to technology, on the one hand, and representational vs. nonrepresentational approaches to landscape, on the other hand. Both system and representational approaches proceed, first hand, by dividing into parts the realm they aim at grasping. Explanation is then targeted at making explicit the articulation between the parts: How do factors affect system? How does landscape as a factor affect RE technology as a system? How do RE technology infrastructures affect landscape as a system of interdependent variables or dimensions? How does landscape, as social representation and symbol, impact on human perception and behavior, thus influencing the course of RE technology development? As entitiness is a prerequisite for the analysis, this framework tends to fall short, always referring back to existing entities and relations when issues at stakes point to the emergence of new entities, such as energy landscapes. Different from this, process approach to technology and nonrepresentational approach to landscape hold back such categorization into parts. "Entitiness," so to say, is the problem: How do RE technologies emerge? How do they acquire their perimeter, homogeneity, and territoriality? How do they recompose social relations and practices around them? How do these relations and practices end up composing emerging social entities? How do new spaces and landscapes emerge as social entities from such relations and practices? Process, displacement, and recomposition are the focus of analysis. Entities are the outcome. For instance, Bonta's analysis in Honduras does not so much analyze the shortfall of "idealized" conservation policy. It traces the process through which cloud forest area is engaged in a new becoming under the influence of local people practices with forest space (migrant agriculture), of an alleged "conservation space" (Honduran "paper park"), and of the prospect of an hydroelectric project. This actual becoming, both local (growing acceptance of a Honduran paper park among local people) and forest (people pro-forest, pro-environment practices), weaves together but also displaces and reinvents preexisting qualifications and practices of this space, bringing about new networks and relations.

One difference between these two frameworks is that system approach has a difficulty to follow and to trace the emergence of new entities, because the categorization of these entities has to be given before the analysis. In other words, within this approach, energy landscape should be defined ex ante for their emergence to be analyzed. Case studies such as Honduran cloud forest, Narbonnaise wind power planning, or French wind power policy (see Chap. 5 in this volume) prove that the core issue at the crossroad between energy transition and landscape is that *energy landscapes rarely fit in the existing landscape qualifications*. While this will of course depend on the country under consideration, chances are that in many cases, we will, as Paul Selman (2010) terms it, have to "learn to love non-carbon landscapes". Said differently, the reordering of our priorities through that of the climate energy issues is bringing a new angle to the questions of what makes landscapes and what landscapes are made for. It is an occasion to revisit the relevance of the ways and tools we have at hand to approach landscapes.

These considerations call for analyses at the crossroad of landscape, planning, and energy issues which enable us to follow the successful or unsuccessful emergence of energy landscape, without necessarily casting energy landscapes in the frame of exiting landscapes and landscape qualification. Rather, we shall acknowledge that energy landscapes raise an issue of becoming and of evolving landscape qualifications, understood as a shared way in which we perceive and appreciate landscapes. This is not meant to impose a unique frame for analysis, but to direct attention to the methods and frames of analysis which are used when following, describing, or arbitrating the emergence of energy landscapes.

2.5 Conclusion

Our analysis has pointed at two different approaches to technology: process approach and system approach. Both are multidimensional but they differ as to their ability to grasp emergence and newness. System approach tends to analyze the complex web of co-influences between existing entities as they form a system. Process approach brings emphasis on the emergence of new technologies as socio-technical networks and the way in which technologies, as they emerge, recompose social collectives and relations. We also pointed at different conceptions of landscape. We distinguished between landscape as a visual entity, expression of cultural and political power on the one hand, and landscape as a multifaceted cultural process, both a representation and materiality made up of social relations and practices on the other.

Looking at the literature about renewable energy technologies, we have pointed at the difficulty in articulating the different dimensions of renewable energy, landscape planning, and renewable energy planning. Several reasons seem to underlay this difficulty including a bias, in the early literature, in favor of RE development and a way of framing wind power opponents as uncivic. As we gained experience, with the number of project developed in different countries and the number of research projects under way on the subject matter, the type of project and the type of process under consideration appeared to matter a lot. Emphasis has been brought on the ways in which energy planning and spatial planning were or could be (or not) articulated in a coherent approach encompassing the different dimensions of wind power landscapes. In this regard, it appears important to consider the landscape as active in territorial planning and power planning. International comparisons also brought insight on the importance of landscape cultures, national traditions of landscape protection. On these also depends the degree of conflictuality of renewable energy development and landscape issues and the extent to which different stakeholders can (or not) gain access to planning process so as to voice the way in which they perceive and practice the landscape.

In some situations, existing landscape qualification, understood as a shared way in which we perceive and appreciate landscapes, is enough to underlay the collective search for suitable renewable energy development areas. In such cases, integrative planning approaches can rely on existing categories as they work on secured ground. Analyses proceeding through system approach are enough, as you can keep entities as given, such as existing landscape categories and groups of actor, and look at the ways in which multiple factors (relations, co-influences) can be taken into account in planning processes. In part of these situations, there can be a missing link in the articulation between landscape qualification and energy planning institutions or practices, calling for interdisciplinary reinforcement.

In other situations, this is not the case because existing qualifications are there, but they are not enough to address the issues raised by renewable energy development. In such cases, renewable energy development raises a genuine controversy about the categories and practices which underlay usual landscape qualifications. We do not know whether and how renewable energy can be part of what we perceive and practice as being a landscape. Issues do not point at whether renewable energy infrastructures are to be located in a pastoral or in an industrial landscape or even in spaces far away from any heritage landscape (there is no such landscapes or no longer any "no landscape space" available), but at whether the changes in spatiality induced by renewable energies shall or shall not qualify as a landscape. In such cases, current landscape representations, system approach, multi-factorial analyses and planning approaches often fall short providing an understanding of the terms of the controversy and a way out of it. Landscape process, practices, displacement, and social recomposition shall be the focus of analysis.

In other words, cross-national comparison of landscapes of energies should be attentive to the type of landscape tradition at work in each country but also account for the fact that the development of renewable energy projects endows these traditions with a renewed existence: Are these traditions relevant, operational, and integrated to energy planning approaches? Are these traditions still relevant and operational but not called for in energy planning approaches? Are these traditions at the core of the controversy raised by wind power development? Analytical method and focus shall differ depending on the situation under consideration.

References

Akrich M (1989) La construction d'un système socio-technique. Esquisse pour une anthropologie des techniques. Anthropologie et Sociétés 13(2):31. doi:10.7202/015076ar

Bonta M (2005) Becoming-forest, becoming-local: transformations of a protected area in Honduras. Geoforum 36(1):95–112. doi:10.1016/j.geoforum.2004.03.011

Bosley P, Bosley K (1990) California wind energy development: environmental support and opposition. Energy Environ 11(2):171–181

Bosley P, Bosley K (1992) Risks and benefits of wind generated electricity: facts and perceptions. Energy Sour 14:1–9

Brian Arthur W (1989) Competing technologies, increasing returns, and lock-in by historical events. Econ J 99(394):116. doi:10.2307/2234208

Carlman I (1986) Public opinion on the use of wind power in Sweden. In: Proceedings of European wind energy conference. Bookshop for Scientific Publications, Rome, pp 569–573

Carlsson B, Stankiewicz R (1991) On the nature, function and composition of technological systems. J Evol Econ 1(2):93–118. doi:10.1007/BF01224915

Cosgrove DE (1998) Social formation and symbolic landscape. University of Wisconsin Press, Madison

Cosgrove DE, Daniels S (1998) The iconography of landscape. Cambridge University Press, New York

Cowell R (2010) Wind power, landscape and strategic, spatial planning—the construction of 'acceptable Locations' in Wales. For Trans Wind Power Plan Landsc Publics 27(2):222–232. doi:10.1016/j.landusepol.2009.01.006

Devine-Wright P, Devine-Wright H (2006) Social representations of intermittency and the shaping of public support for wind energy in the UK. Int J Global Energy Issues 25(3–4):243–256

Dosi G (1982) Technological paradigms and technological trajectories: a suggested interpretation of the determinants of technological change. Res Policy 11:147–162

Duncan J, Duncan N (1988) (Re)reading the landscape. Environ Plan D Soc Space 6(2):117–126. doi:10.1068/d060117

Foray D, Freeman F (1992) Technologie et richesse des Nations. Economica, Paris

Frolova M (2010) Landscapes, water policy and the evolution of discourses on hydropower in Spain. Landsc Res 35(2):235–257

Geels FW (2002) Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. Res Policy 31(8–9):1257–1274. doi:10.1016/S0048-7333(02)00062-8

Grübler A, Nakićenović N, Victor DG (1999) Dynamics of energy technologies and global change. Energy Policy 27(5):247–280. doi:10.1016/S0301-4215(98)00067-6

Haggett C (2008) Over the sea and far away? A consideration of the planning, politics and public perception of offshore wind farms. J Environ Policy Plann 10(3):289–306

Haggett C, Toke D (2006) Crossing the great divide—using multi-method analysis to understand opposition to windfarms. Public Adm 84(1):103–120

Hirsch E, O'Hanlon M (eds) (1995) The anthropology of landscape: perspectives on place and space. Clarendon Press, Oxford

Hughes T (1986) The seamless web: science, technology, etcetera, etcetera. Soc Stud Sci 16(2):281–292

Huitjs N, Midden C, Meijnders A (2007) Social acceptance of carbon dioxide storage. Energy Policy 35(5):2780–2789

Jackson JB (1997) Landscape in sight: looking at America. Yale University Press, New Haven
Jolivet E, Heiskanen E (2010) Blowing against the wind–an exploratory application of actor network theory to the analysis of local controversies and participation processes in wind energy. Energy Policy 38(11):6746–6754. doi:10.1016/j.enpol.2010.06.044
Krauss W (2010) The 'dingpolitik' of wind energy in northern German landscapes: an ethnographic case study. Landsc Res 35(2):195–208
Lorimer H (2005) Cultural geography: the busyness of being 'more-than-representational'. Prog Hum Geogr 29(1):83–94. doi:10.1191/0309132505ph531pr
Lundvall B (1992) National systems of innovation: towards a theory of innovation and interactive learning. Pinter Publishers, London, New York, distributed exclusively in the USA and Canada by St. Martin's Press
Nadaï A (2007) 'Planning', 'siting' and the local acceptance of wind power: some lessons from the French case. Energy Policy 35(5):2715–2726
Nadaï A (2012) Planning with the missing masses: innovative wind power planning in France. In: Szarka J, Cowell R, Ellis G, Strachan P, Warren C (eds) Learning from wind power: governance, societal and policy perspectives on sustainable energy. MacMillan, Palgrave, Basingstoke, Hampshire (UK), p 280
Nadaï A, Labussière O (2010) Birds, wind and the making of wind power landscapes in Aude, southern France. Landsc Res 35(2):209–233
Nadaï A, Labussière O (2013) Playing with the line, channelling multiplicity: wind power planning in the Narbonnaise (Aude, France). Environ Plan D Soc Space 31(1):116–139. doi:10.1068/d22610
Nadaï A, Labussière O (2015) Wind power and the emergence of the Beauce landscape (Eure-et-Loir, France). Landsc Res 40(1):76–98. doi:10.1080/01426397.2013.784732, http://www.tandfonline.com/doi/abs/10.1080/01426397.2013.784732?journalCode=clar20#.VPA1e47LKWl
Nadaï A, van der Horst D (2010) Introduction: landscapes of energies (Guest editorial). Landsc Res 35(2):143–155
Nadaï A, Krauss W, Afonso AI, Dracklé D, Hinkelbein O, Labussiere O, Mendes C (2010) El paisaje y la transición energética: Comparando el surgimiento de paisajes de energía eólica en Francia, Alemania y Portugal. Nimbus 25–26:155–173
Nadaï A, Krauss W, Afonso AI, Dracklé D, Hinkelbein O, Labussière O, Mendes C (2013) Une comparaison de l'émergence de paysages éoliens en France, Allemagne et Portugal. In: Terrasson D, Luginbuhl Y (eds) Paysage et Développement Durable. Quae, Versailles, pp 157–169
Nelson R, Winter S (1977) In search of a useful theory of innovation'. Res Policy 6:36–76
Nelson RR (1993) National innovation systems: a comparative analysis. Oxford University Press, New York and London
Nelson R, Winter S (1982) An evolutionary theory of economic change. Harvard University Press, Cambridge
North DC (1990) Institutions, institutional change, and economic performance. The political economy of institutions and decisions. Cambridge University Press, Cambridge/New York
Olwig KR (1996) Recovering the substantive nature of landscape. Ann Assoc Am Geogr 86(4):630–653. doi:10.1111/j.1467-8306.1996.tb01770.x
Olwig KR (2002) Landscape, nature, and the body politic: from Britain's renaissance to America's new world. University of Wisconsin Press, Madison
Olwig KR (2005) Editorial: law, polity and the changing meaning of landscape. Landsc Res 30(3):293–298. doi:10.1080/01426390500165369
Olwig KR (2007) The practice of landscape 'Conventions' and the just landscape: the case of the European landscape convention. Landsc Res 32(5):579–594. doi:10.1080/01426390701552738
Owens S (1985) Energy participation and planning: the case of electricity generation in Great Britain. In: Calzonetti FJ, Solomon BD (eds) Geographical dimensions of energy. Reidel Publishing Company, Dordrecht, pp 225–254
Pasqualetti M (2011) Opposing wind energy landscapes: a search for common cause. Ann Assoc Am Geogr 101(4):907–917

Pasqualetti M, Gipe P, Righter RW (2002) Wind power in view. Energy landscapes in a crowded world. Academic, San Diego
Prados MJ (2010a) ¿Energías renovables o agricultura? Un análisis de la percepción ciudadana sobre los huertos y latifundios solares en Andalucía. Nimbus 25–26:205–229
Prados MJ (2010b) Renewable energy policy and landscape management in Andalusia, Spain: the facts. Energy Policy 38(11):6900–6909
Rose M (2002) Landscape and labyrinths. Geoforum 33(4):455–467. doi:10.1016/S0016-7185(02)00030-1
Rose M, Wylie J (2006) Animating landscape. Environ Plann D Soc Space 24(4):475–479. doi:10.1068/d2404ed
Sauer CO (1963) Land and life. University of California Press, Berkeley
Schot J, Geels FW (2008) Strategic niche management and sustainable innovation journeys: theory, findings, research agenda, and policy. Technol Anal Strat Manag 20(5):537–554. doi:10.1080/09537320802292651
Selman P (2010) Learning to love the landscapes of carbon-neutrality. Landsc Res 35(2):157–171. doi:10.1080/01426390903560414
Suurs RAA (2009) Motors of sustainable innovation. Towards a theory on the dynamics of technological innovation systems. Utrecht University
Szarka J (2004) Wind power, discourse coalitions and climate change: breaking the stalemate? Eur Environ 14(6):317–330
Thrift N (2000) Afterwords. Environ Plan D: Soc Space 18(2):213–255. doi:10.1068/d214t
Thrift N (2004a) Movement-space: the changing domain of thinking resulting from the development of new kinds of spatial awareness. Econ Soc 33(4):582–604. doi:10.1080/0308514042000285305
Thrift N (2004b) Afterwords. Environ Plann D Soc Space 18(2):213–255. doi:10.1068/d214t
Unruh GC (2000) Understanding carbon lock-in. Energy Policy 28(12) (October, 1):817-830. doi:10.1016/S0301-4215(00)00070-7
Van der Horst D (2007) NIMBY or not? Exploring the relevance of location and the politics of voiced opinions in renewable energy siting controversies. Energy Policy 35(5):2705–2714
Van der Horst D, Toke D (2010) Exploring the landscape of wind farm developments, local area characteristics and planning process outcomes in rural England. Land Use Policy 27:214–221
Varley MJ, Davies TD, Bentham CG, Pautikof JP (1989) Local attitudes to three existing wind turbine in the UK. In: Swill-Hook DT (ed) Wind energy and the environment. Peregrinus, Stevenage, pp 146–159
Walker G (1995) Renewable energy and the public. Land Use Policy 12(1):49–59
Walker G (2007) Public participation as participatory communication in environmental policy decision-making: from concepts to structured conversations. Environ Commun 1(1):99–110
Warren CR, Mcfadyen M (2010) Does community ownership affect public attitudes to wind energy? A case study of 'acceptable locations' in Wales. Land Use Policy 27:204–213
West J, Bailey I, Winter M (2010) Renewable energy policy and public perceptions of renewable energy: a cultural theory approach. Energy Policy 38(10):5739–5748
Whatmore S (2002) Hybrid geographies: natures, cultures, spaces. Sage, London
Winner L (1980) Do artifacts have politics? Daedalus 109(1):121–136. doi:10.2307/20024652
Wolsink M (1988) The social impact of a large wind turbine. Environ Impact Assess Rev 8:323–334
Wolsink M (2007) Planning of renewables schemes: deliberative and fair decision-making on landscape issues instead of reproachful accusations of non-cooperation. Energy Policy 35(5):2692–2704
Woods M (2003) Conflicting environmental visions of the rural, wind farm development in Mid-Wales. Sociol Rural 43(3):271–288
Wüstenhagen R, Schweizer-Ries P, Wemheuer C (2007) Social acceptance of renewable energy innovation: an introduction to the concept. Energy Policy 35(5):2683–2691
Zoellner J, Schweizer-Ries P, Wemheuer C (2008) Public acceptance of renewable energies: results from case studies in Germany. Energy Policy 36(11):4136–4141

Part II
Development of New Energies and Emerging Landscapes

Chapter 3
A Country of Windmills

Wind Energy Development and Landscape in Spain

Eugenio Baraja-Rodríguez, Daniel Herrero-Luque, and Belén Pérez-Pérez

Abstract The development of the wind energy sector in Spain is a special case in Europe. A stable regulatory framework, an attractive, financial incentive system and a powerful industry came together to produce a deployment process that was both swift and unopposed. Nonetheless, the rapid development of such an extensive energy source has led to conflict between its supporters and opponents and has had a dramatic impact on land use and the landscape, by giving the rural space a new function and by affecting or altering existing landscapes or even by building a new kind of landscape. The economic crisis has brought this accelerated development to an abrupt end, and society's attitude to it has also changed. The wind sector, with its contradictions and conflicts, has contributed decisively to intensifying the territorial debate and to arousing social awareness of landscape in Spain.

Keywords Energy landscape • Wind energy development in Spain • Landscape conflicts • Local acceptance • Land-use change

3.1 Introduction

Windmills have been a constant feature of the Spanish landscape since ancient times. Most frequently used for grinding cereal on Spain's arid inland plains, these machines became part of one of Spain's most famous stereotypical images (that of its best-known literary hero, Don Quixote). Today the image of a country of windmills is with us once again as a result of the proliferation of wind turbines producing

E. Baraja-Rodríguez (✉) • D. Herrero-Luque
Departamento de Geografía, Facultad de Filosofía y Letras, University of Valladolid,
Plaza del Campus s/n, 47011 Valladolid, Spain
e-mail: baraja@fyl.uva.es; herrero@geo.uva.es

B. Pérez-Pérez
Facultad de Filosofía y Letras, Universidad de Granada,
Campus de Cartuja s/n. 18071, Granada, Spain
e-mail: belenperez76@gmail.com

M. Frolova et al. (eds.), *Renewable Energies and European Landscapes*,
DOI 10.1007/978-94-017-9843-3_3

electricity. There is now one wind turbine for every 25 km^2. The outdated stereotype of Don Quixote has been replaced by a new, highly visible phenomenon, which is spreading fast across the whole country and which has not only had revolutionary effects on rural landscapes, but, by introducing new elements, functions and meanings (assimilation, rejection, indifference, etc.), has also created its own new landscapes.

In barely a decade, Spain has witnessed one of the most spectacular processes of wind power development in Europe, in terms of both scale and speed. This rapid expansion has meant that wind power now contributes 15.75 % of total electricity production (2011), so reducing Spain's traditional dependence on imported energy and limiting CO_2 emissions. At the same time a powerful manufacturing industry has grown up to supply the wind energy sector, which is now a world leader in various segments of the value chain and is actively involved in new energy projects all over the world.

This does not mean, however, that the deployment of wind energy has all been plain sailing. Its swift expansion has created a series of contradictions and conflicts which in the end have provoked a response from certain sections of society. In fact, the growth of wind energy and extensive, dispersed building development and large, new communications infrastructures are all part of a process that has brought profound change to Spanish landscapes in recent years (Nogué 2008), revealing the serious deficiencies of territorial management particularly in areas not covered by specific protection measures. The ratification of the European Landscape Convention (ELC) in 2007 may help remedy this problem, but its implementation in sectorial and territorial policies has so far been slow in comparison with the magnitude and intensity of the changes.

In addition, the manner in which wind energy has been deployed, characterised by a high concentration of turbines and little or no public participation, explains why public opinion has gradually shifted from its initial sympathy towards what was perceived as a modern, environmentally friendly energy source to current questioning and even rejection. This feeling is however not shared by those who after living in long-neglected areas have begun to assimilate and even to benefit from a form of energy production that has brought their areas into the modern economy.

It is therefore essential to discover what made wind energy deployment in Spain different from that in other countries. What factors stimulated its growth? What impacts and conflicts has it caused and how do they manifest themselves on the ground and in the landscape? This chapter tries to provide answers to these and other questions through a methodological approach that begins by analysing the political, administrative and social factors that have contributed to the development of wind energy, before going on to describe the economic and territorial results and the most important impacts, tensions and conflicts arising from the deployment of wind energy on a massive scale. To this end we have consulted statistical sources, sectorial reports and the increasingly abundant scientific literature on energy, which approaches the question from a range of different perspectives. These tensions and conflicts have been exacerbated by the fact that deployment has been geographically quite uneven, with very high concentrations in certain areas, while others remain almost undeveloped. For this reason and last of all, we present three case studies of the different interpretations of landscape and territory resulting from wind energy development in mountain, plain and coastal environments, in natural, urban and tourist settings, which provide excellent examples of different territorial dynamics and for which we have carried out studies on the ground that include analysis of the processes and interviews with the main stakeholders. All of this leads us to conclude that in different formats (high concentrations in parks on the plains, long lines of turbines in the mountains, etc.) and from different viewpoints (assimilation, opposition, etc.), the deployment of wind energy has helped to liven the territorial debate and has contributed to the slow awakening of social awareness as to the value and importance of landscape in Spain.

3.2 Factors Explaining the Development of Wind Energy in Spain and Its Unique Deployment Process

In every process there are forces driving it forward and forces reining it back. In the development of wind industry in Spain, the latter forces, represented by landscape conservation, planning and management within a participative context, are extremely weak when compared with the strength and vigour of the former, represented by very active economic agents who have made the most of advantageous financial conditions and a stable framework within which to operate.

3.2.1 An Abundant Resource, a Highly Favourable Political and Financial Framework and Some Active Developers

The average speed and the frequency of winds are key parameters in electricity generation. As a result of the situation, the extension, the disposition of the terrain and the diversity of influences in the Iberian Peninsula and its islands, areas such as the Strait of Gibraltar, the coast of Galicia, the Ebro Valley and the inland mountain ridges receive winds with sufficient frequency and speed to produce electricity in profitable conditions. In fact, most of the wind power installations in Spain are situated in these areas, which have wind regimes with between 2,000 and 3,000 equivalent full-load hours (Fundación para Estudios sobre la Energía 2010: 79).

The fact that Spain is blessed with a plentiful supply of wind does not by itself explain the spectacular expansion of wind turbines. For this to come about, it was also necessary to establish a stable regulatory framework and a strong political commitment expressed in the form of medium- and long-term financial incentives (Fundación para Estudios sobre la Energía 2010: 28). This policy of incentives and feed-in tariffs per kWh is the main factor behind the development of the wind energy sector in this country. This policy is neither new nor exclusive to Spain (IRENA

2012), but it is atypical and therefore of particular interest because of its uneven evolution lurching in little over a decade from a phase of explosive development to the current situation of almost complete stagnation.

Although a succession of renewable energy plans has been published since the mid-1980s (Law 82/1980, Renewable Energy Plan (REP) 1986, Energy Saving and Efficiency Plan (PAEE) 1991–2000), the real boost to the wind sector did not come until the second half of the 1990s (Law 54/1997, Royal Decree 2818/1998). There were three main factors that created the conditions in which this could occur. Firstly, there was a sharp increase in the demand for energy; secondly, the Spanish government decided that it should try to comply with the targets set down by the EU in relation to renewable energies; and, thirdly, government incentives combined with cheap, readily available credit made wind energy an attractive investment. The result was that larger projects were undertaken and the installed capacity grew at such spectacular rates that from 2008 it became evident that the rules for access to the grid and the incentive system had to be adjusted. This led to direct cuts in the premiums and changes in the rules to reduce the amounts payable. Mechanisms were also established to control the application and approval procedures for new projects. This ushered in a period of cuts and rationalisation which concluded with the abrupt halt brought about by Royal Decree Law 1/2012 which, in order to reduce the *deficit tarifario* (the debt owed by the state to the electricity companies), temporarily suspended the premiums payable to new installations. Although this did not have retroactive effect and projects that had already been approved are still going ahead, the moratorium provided legal confirmation for what was already a fact on the ground, a situation created by the fall in the demand for electricity as a result of the profound economic crisis in which the country is currently immersed.

In addition, restrictive measures imposed by the government have created a situation of uncertainty which, as wind power developers complain, is hitting the whole value chain, causing Spain to fall back in the international ranking in the sector. A powerful industry has developed around the wind energy sector, which covers the main subsectors of the business: wind power developers/energy producers, wind turbine manufacturers and manufacturers of specific components and associated services (Espejo and García 2012: 123). In some cases, these are new companies that have emerged and developed, attracted by the potential of the new renewable energy business; in other cases they are established companies from the conventional energy sector, who see the wind power business as an opportunity to diversify their energy sources. Companies such as Iberdrola Renovables, Acciona Energía, Gamesa or EDP Renewables are just a few of those leading the way in this sector. They are also at the head of important national and international innovation projects and play an active role in wind power development all over the world. Unlike other countries in which developers come in many shapes and forms (local councils, cooperatives, associations, etc.), in Spain this powerful industry has been the driving force behind the deployment and the dynamism of the wind energy sector.

3.2.2 A Deployment Model Characterised by Varying Administrative Frameworks, the Absence of Any Landscape Regulations and a General Lack of Opposition

Wind resources and stable, attractive legal frameworks also exist in other European countries. However, wind power in these countries developed in a different way from Spain both in terms of the form of deployment and of its scope. There are also significant differences within Spain itself from one autonomous region to the next. This is because the deployment of wind turbines depends on the rules and procedures that must be followed to obtain the relevant authorisations, certifications and licences issued by the different administrations with powers and responsibilities in this field and that as a result 'the institutional and juridical context within which decisions are taken and their subsequent implementation and monitoring, the degree of stakeholder participation, the presence or absence of debates and conflicts, (…) may vary significantly from one country and/or region to another' (Frolova 2010: 96).

In Spain there are essentially three tiers of government: central, regional and local. Local authorities grant the licences for installations within their municipal areas. Central government allocates to each region the electricity generation quotas or targets established in European Directives on the basis of the absorption capacity of the state electricity grid (*Idem*), and although Decree Law 6/2009 introduced a certain degree of recentralisation of decision-making, it is the regional governments that hold the keys to integrating energy development within their spatial framework, i.e. coordinating energy planning and land-use policy.

As a result, the deployment of wind energy in Spain has been far from homogeneous. In addition to the geographical differences and the landscape diversity, the different regions (known as 'autonomous communities') have their own legislative framework and their own 'territorial culture'. Some have delayed or postponed the development of wind power by imposing moratoria (Extremadura, Madrid, etc.), whereas others have stimulated its rapid deployment by offering incentives and working hand in hand with their industrial sector (Navarra, Castilla y León, Castilla-La Mancha, etc.). In any case, the different regional authorities have drawn up resource maps and identified exclusion zones and areas for priority development. They have also established the procedures for companies wishing to develop wind energy projects with concessions by invitation to tender, competition, etc. The regions have full powers to legislate on industry, town planning and the environment, with the result that the authorisations and permits required to set up these installations have been regulated independently by each region (IDEA 2010: 64). The only common factors are the limited implementation of regulations regarding landscape and the role of public participation. The fact that the conservation, planning and management of the landscape were not institutionalised in Spain until the first decade of the twenty-first century (the ELC came into force in Spain in 2008) is considered to be one of the most important factors in the success of the deployment of renewable energy systems (Frolova 2010: 101). Another equally important factor should also be taken into account, namely, the relative lack of public opposition.

Indeed, in other European countries, 'the sensitivity towards rural landscapes and the strong social opposition to wind-park projects has been a major obstacle preventing countries from meeting EU renewable energy targets' (*Idem*: 94). Unlike the United Kingdom, Denmark or Sweden, in Spain the deployment of wind energy has been both swift and unchallenged (Warren et al. 2005; van der Horst and Toke 2010; Möller 2010). There are a number of reasons for this: (1) Spain is a large country with a lot of relatively unpopulated open spaces; (2) this form of energy has enjoyed wide popular support because it is considered environmentally friendly; and above all, (3) the dominant planning model 'has been markedly hierarchical, authoritarian and functional', a model in which 'renewable energy project developers put significant pressure on the different authorities and on society, so ensuring that the bureaucratic, planning and environmental procedures involved in the development of renewable energy systems are speeded up as much as possible, as they consider them an obstacle to the financial viability of their projects' (Frolova and Pérez Pérez 2008: 296).

This is the key: a model in which very little public participation is combined with a highly tolerant, permissive attitude on the part of society with regard to the conservation of the territory and its landscape, an attitude that is closely related to the consideration and the value (often very low) accorded to them. This explains why public opposition has so far been very limited and has only really occurred in places with a high density of installations, or where there are important conflicts with other possible land uses (tourism businesses, second homes, etc.) or where the high environmental or cultural value of the site has mobilised the most highly aware, most active groups (ecologists, scientists, citizens' platforms).

3.3 Results of the Process: Light and Shade in Wind Energy in Spain

The combination of all these factors has produced the spectacular development of wind power in Spain. Its contribution to total electricity production is becoming increasingly important, as therefore is its contribution to the Spanish economy in general. On the downside its deployment has had dramatic impacts on the affected areas, which have given rise to conflicts and tensions.

3.3.1 The Scale of Wind Energy Production and Its Economic Importance

Installed wind power capacity in Spain has increased tenfold in just a decade leaping from 2,365 MW in the year 2000 to 21,091 MW in 2011, placing Spain second in Europe behind Germany and fourth in the world behind China and the United States. As a result of this rapid expansion, wind power produced 41,799 GWh of electricity in 2011, thereby covering 16.4 % of total demand. One of the negative characteristics of this energy source is the high variability of wind levels, which has led to situations on calm days in which wind energy produces as little as 1 % of total electricity production and other days in which high winds produce up to 46 %, levels at which turbines have to be disconnected to limit the input into the grid (Espejo and García 2012: 119). Another important factor is that wind power has reached a higher degree of technological maturity than other renewables, progressively reducing the difference between the cost of each kW produced and that of conventional energy sources.

In short, wind energy has gone from being almost unknown in Spain at the beginning of the 1990s (7 MW installed capacity) to becoming the fourth-largest electricity production technology in Spain by volume of production behind nuclear, coal-fired and combined cycle power stations. The contribution it makes is of key strategic importance for a country highly dependent on imported primary energy and is a prime source of wealth for the Spanish economy.

Indeed, in 2011 the wind energy sector contributed 2,623 million euros (0.25 %) to Spanish GDP, providing jobs either directly or indirectly to 27,119 people (Deloitte 2012: 6). In addition, Spanish wind power companies have factories in different parts of the country that make components, with exports worth an average of 1,100 million euros (ICEX 2012) a year. These companies are widely viewed on the international market as examples of technological excellence. But the important position of wind power in the new energy supply structure based on renewable sources (defined by some as the 'Third Industrial Revolution' – Fundación para Estudios sobre la Energía 2010) goes beyond mere economic statistics. It has been valued as a symbol of modernity and of the future in a country that has lived for too long under the stigma of its late start in the first Industrial Revolution and its traditional dependence on foreign research, innovation and production (Ardillier-Carras et al. 2011).

In addition and although compared with their macroeconomic importance the benefits from wind power at a local level are marginal, their impact should not be scorned. The construction of wind parks is a source of employment, as is, albeit to a lesser extent, their maintenance, in areas that normally have a somewhat sluggish labour market. They also bring considerable investment in the community in terms of the acquisition or rental of land, the building works, the operation and the maintenance costs. This provides income for local councils via taxes and in the form of services provided in exchange. Wind power has brought with it a certain 'modernity' and multifunctionality, bringing a degree of economic dynamism to areas often either abandoned or devoted to extensive farming, above all if we consider that the presence of wind turbines is compatible with livestock grazing or agriculture. In short it has been an economic lifeline for many marginal areas, a fact which explains at least in part why there has been so little opposition from local people, so confirming the hypothesis put forward by D. van der Horst and L.M. Lozada-Ellison (2010: 238–239) that 'sympathy or support for wind-parks is stronger amongst people who maintain a relationship with a rural existence that is economically fragile and depends to a large extent on the primary sector, or in other words, on the productivity of the land'.

3.3.2 A Wide Deployment of Wind Power Across the Country Creating New Landscapes in the Form of Lines of Turbines and Wind Parks

Wind energy planning, in those Spanish regions that have made such plans, establishes a series of location parameters which try to combine technical and environmental feasibility in accordance with the site's reception capacity, defined both in terms of the potential of the resource (wind speed and frequency) and its capacity for transmission of the electricity produced.

Initially and from the resource perspective, the best sites were in the most exposed coastal areas and on inland mountain ridges. The map in Fig. 3.1 clearly illustrates these preferences with a high concentration of wind installations on the west coast (Galicia and Andalusia) and in the Cantábrica, Ibérica and Costero-Catalana mountain ranges. This location pattern was also justified by the need to maximise the performance and the profitability of the available wind turbines, which at that time had a very limited capacity (650 kW in the year 2000). Because of the direction and frequency of the winds, and in order to avoid the 'wake' effect (Ardillier-Carras et al. 2011), wind turbines have generally been positioned in lines on the crests of hills. The impact of this line formation on the landscape is easy to imagine especially in the case of high power capacity projects: the need to position the turbines in lines 'stretches' their location, blurring possible divisions and emphasising their presence on the horizon. Opponents of wind power refer to them as 'crucified hills', and they have been the source of various territorial conflicts due to their high visibility.

Since then, however technical advances have enabled turbines to be installed in areas with lower wind speeds, a new generation of more powerful machines (by 2010 the average power capacity had risen to 1,900 kW) and other improvements facilitating the installation and transmission of the electricity production combined

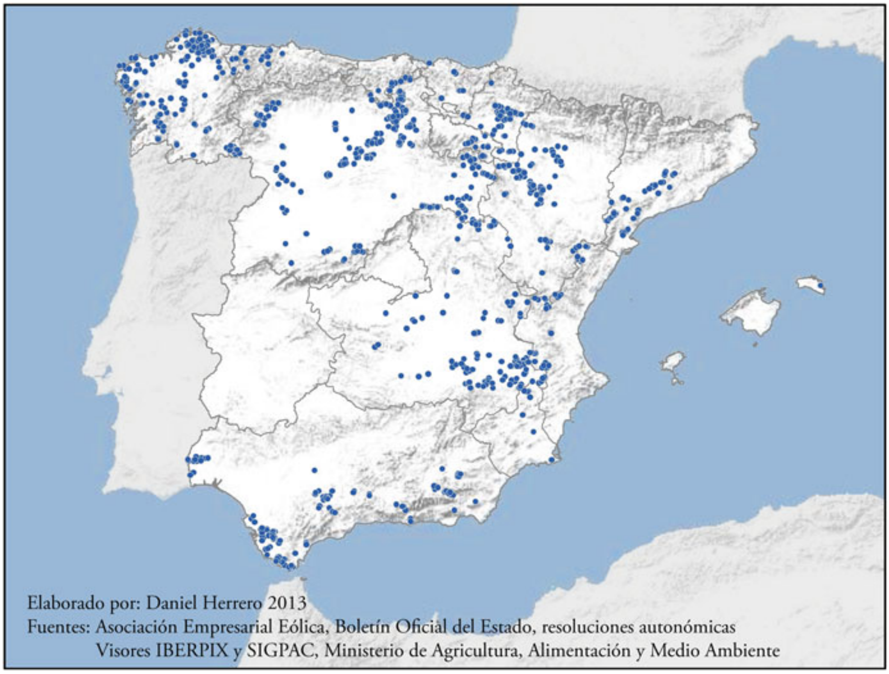

Fig. 3.1 Distribution of wind parks in Spain in 2012

to allow turbines to move inland towards the high plains of Castilla y León, Castilla-La Mancha and the Ebro Valley (Fig. 3.1), where in many cases they took the form of a 'park'. In spite of their density, they do not interfere with other agricultural or livestock uses, and their presence and impact on the landscape have provoked less opposition.

In any case, and unlike other countries (such as Germany), in Spain single, isolated machines or small groups of them are a rare sight. On the contrary, Spain has opted for a model of development whose most common expression is a concentration of windmills, either well aligned or well grouped, depending on the abundance of the resource and the morphology of the land. This high concentration brings savings in the costs of substations and transmission lines to grid connection points, but it also consumes more space.

It is at these high levels of concentration and visibility, in coastal areas, in lines on mid-mountain ridges or on high barren inland plateaus, that most conflicts arise, even if the development companies argue in their support that high concentrations of wind turbines have less environmental impact than large numbers of scattered, small projects, as well obviously as being more profitable for the developers in economic terms.

The new wind power installations which initially had been installed in small numbers began to proliferate, covering large expanses of land. They were no longer isolated installations that altered or affected the landscape; they were now creating their own new form of landscape, with precise forms (lines, parks, etc.) with a clear function (energy production) and with new discourses that produced opposition, assimilation or indifference. The combination of this 'explosive' development of wind energy with other territorial processes with a strong impact on the landscape, such as large communication infrastructures or scattered urban development, led to increasing concern in society about land use, the landscape and its values. From a general perspective, the deployment of wind power has served to rekindle the debate about land management and the degradation of the landscape. In this context and on different scales, opposition movements have emerged. At the same time from a local perspective, daily life alongside these installations has given rise to new practices. There are many stakeholders (individuals, institutions, etc.) who value the economic benefits of wind power, particularly in deprived or abandoned rural areas. This makes this new energy source easier to assimilate and at times has led to it being considered a symbol of modernity.

3.3.3 Impacts, Tensions and Conflicts: The Landscape as a Backdrop

The rapid, intensive deployment of such an extensive form of energy production has inevitably had dramatic territorial impacts. The most important of these impacts is of an environmental or landscape nature and arises both from their need for space and because of the height of the turbines (which including the blades can often rise as much as 140 m above the ground).

The environmental impact is exacerbated if the wind turbines are installed in the vicinity of or inside protected natural spaces. This happens quite frequently in Spain given that protected areas often border on mountain or coastal areas with abundant wind energy resources. In theory the impact on the environment can be measured and controlled, as the territory is classified into different categories of environmental sensitivity and the forms in which wind power can be deployed are regulated. A favourable environmental assessment is also required. However, the fact that certain developments that had been seriously challenged were given the green light and are now in service highlights the legal loopholes that enable installation applications to prosper (large projects divided into several smaller ones, sites on the edges of protected areas, etc.). Others however have been suspended provisionally by the government or have been halted by court judgements that cite their irreversible impact on the landscape.[1]

[1]A good example is Resolution 140/2011 issued by the Court of Administrative Law (JCA) in Lleida in relation to a wind park in the municipal area of Vallbona de les Monges, which described the installation of the park as an 'unacceptable situation of *faits accomplis* in which, without any legislative backing whatsoever and supported solely by administrative licences and authorizations, general systems are implemented, similar to the case in hand, with the impact, at the very least on

One of the most striking aspects of the impact of wind power deployment often raised by its opponents in Spain is the banalisation of the landscape, in which traditional landscapes are replaced by others devoid of content and substance that are hostile to cultural values and are completely out of step with the traditional 'discourse' of the local territory, into which wind turbines are always difficult to insert and which result in essence from the idea that the space serves no other purpose than as a medium in which to install the infrastructures. At the same time it should be stressed once again that this view is not shared by those who consider wind parks as new symbols of modernity or by those who stand to gain from the economic benefits they bring, above all in areas with weak or declining economies.

In these cases, when economic benefits are at stake, tensions arise because of competing land uses. This happens in certain mountain areas, in which the turbines clash with sports uses (e.g. paragliding), leading to conflicts between the owners of land that could potentially be used for wind energy installations and others with interests in sport and leisure. The greatest opposition occurs however in areas that have opted for rural tourism and nature as a motor for development, in which the presence of large numbers of turbines apparently damages the resources that sustain them: landscape in the sense of a scene or setting in which wind turbines are alien elements that disrupt the harmony of the composition.

Conflicts also arise between adjacent territories or different government bodies. This is a typical feature of the 'frontier' effect. The location and visibility of the turbines mean that their impact is shared, but the benefits, when they exist, only accrue to one of the parties. Due to their importance for the local economy, the most frequent form of confrontation is between neighbouring town councils or residents' associations, who fight over the land that is to 'benefit' from being chosen as the site for a wind energy project. At times however, these disputes transcend the local level, and regions with different approaches to territorial planning become embroiled in conflict. There have even been examples of tensions between neighbouring countries, as has happened in certain areas on the border between Spain and Portugal.

3.4 Case Study: A New Vision of the Landscape and the Territory in View of the Development of Wind Energy in Mountain, Coastal and Inland Plain Areas

The image of a very high concentration of wind turbines in very specific types of landscape captures the reality of a Spain of windmills very well, which on occasions goes far beyond the somewhat imprecise 'saturation level'. Natural, technical and construction factors have produced different types of installation which are inserted into different geographical situations. The cases selected for this study illustrate the

---

the landscape, inherent in said systems'. The judgement ended by ordering the demolition of the installations and the return of the land to its original state.

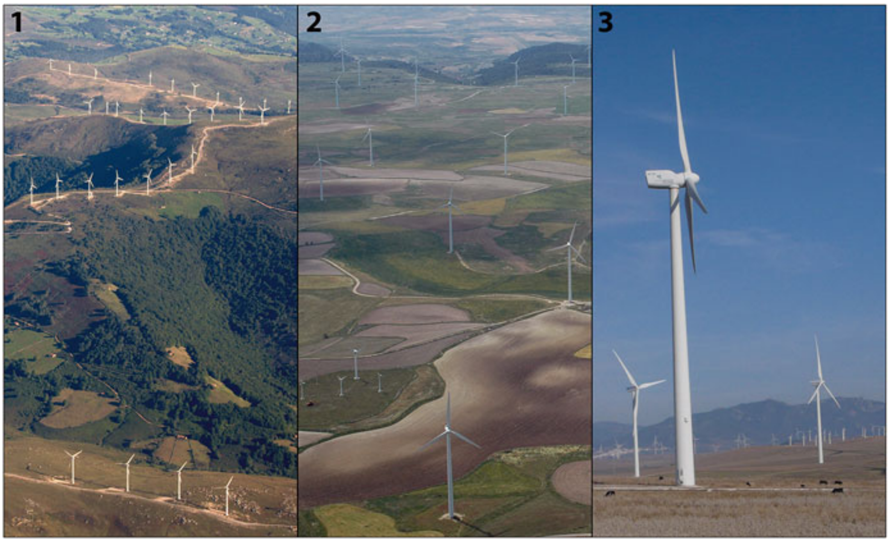

Fig. 3.2 *1*. Turbines in line formation in the Cantabrian Mountains (Photo by Baraja 2010). *2*. High concentration of wind turbines in 'parks' in La Muela, Zaragoza (Photo by Humbert/Casa de Velázquez 2008). *3*. Wind turbines in Zahara de los Atunes, Cadiz (Photo by Baraja 2012)

various forms taken by wind energy development and the conflicts arising from its deployment in Spain and also explore the questions of landscape awareness and territorial planning (Fig. 3.2).

3.4.1 The Cantabrian Cordillera: The Blurred Line Between Environmental Protection and Wind Energy Expansion

The Cantabrian mountain range runs across the North of the Iberian Peninsula and acts as a natural frontier between Atlantic and Mediterranean Spain. It is one of the areas of the country with greatest natural wealth and biodiversity, and the ridge that separates the bioclimatic zones also serves as an administrative division between various different Spanish regions. This mountain range contains an area of special interest that serves as an example to help us understand the impact of what we call the 'frontier effect': the area that acts as a dividing line between Cantabria, to the north, and Castilla y León, to the south. Although there is no fence or other physical barrier between the two regions, the border between them can be clearly distinguished by the line of wind turbines installed on the Castilla y León side.

At the end of the twentieth century, the regional government of Castilla y León opted decisively to develop wind energy and now leads the sector at a national level. The legislative stability in the energy field, linked to the continued hegemony of the same political party in the regional government, was an important factor in this rapid, sustained growth. Energy planning in Cantabria by contrast has changed on numerous occasions due to constant changes in government. In 2001 and only 10 months after procedures for the authorisation of wind parks had been introduced, the Government of Cantabria suspended the acceptance of new applications, so becoming the first Spanish region to declare a 'wind power moratorium'. The aim of the regional government was to analyse the compatibility of wind energy development with environmental conservation. The authorities then decided to protect and defend the regional landscape and heritage. However when the government's main rivals ousted them from power in 2009, land-use planning policy was reversed, permitting the installation of wind parks. Their deployment continues to be plagued with uncertainty as a result of the constant modifications in the forecasts for installable capacity. There were various reasons for this volte-face: the inability of the government to agree on official mechanisms to protect landscape and heritage, the fact that it was impossible to halt the 'invasion' from wind turbines installed on the Castilla y León border and the pressure exerted by companies and banks that considered the energy business an attractive investment.

Today two clearly different situations can be identified in this part of the Cantabrian mountain range where the frontier between the two regions is clearly marked out by lines of wind turbines. Over 300 wind turbines installed on the Castilla y León side occupy the highest mountain areas and structural platforms and prove that wind energy is compatible with protected natural spaces, such as *Hoces del Ebro y Rudrón*, in which over 40 turbines were installed in an area later declared a Natural Park.

The clear, highly visible contrast between the two situations makes this area unique in Spain. This dichotomy between modern and traditional values has made territory and landscape the central features of the conflicts that have broken out.

An initial analysis suggests that the conflict first exploded on the Cantabria side, given the considerable visual impact its landscapes suffered for no economic benefit whatsoever. The combatants in this duel on the 'frontier' were the two regional administrations, and the cause was contradictory, disconnected territorial policies. As a result the border between the two regions became a battle line, in which the long lines of wind turbines seem to have won the day over the defence of the landscape. During the course of this battle, each regional government changed the image of its territory in order to defend its particular cause. Cantabria, eager to preserve its landscape and heritage and use them as a means of attracting tourists, created a new image under the slogan 'Cantabria, Gran Reserva' (in Spanish this offers a play on words as 'Gran Reserva' could refer both to high quality and to a large nature reserve). Castilla y León by contrast projected the image of a modern, sustainable region on the basis that it was top of the national ranking in installed wind energy capacity. Two opposing, contrasting policies therefore resulted in different interpretations of land use that today coexist side by side in the Cantabrian Mountains.

At a local level, the regional frontier and the conflict arising around it seem to be more easily resolved. However, other conflicts centring around the landscape and its economic significance can be observed. The dominant initial reaction amongst the people of Castilla y León was one of scepticism about a wind energy expansion that transformed the landscape of their mountains and valleys, but they were prepared to accept this impact in return for economic benefits. Indeed, in many cases proposals to install wind turbines were greeted enthusiastically by individuals, town councils and communities, as they provided much-needed revenues to bolster meagre municipal budgets and for the local people that owned the land.

However, the ill-judged use of these benefits led to protests about the way the question was handled by the local government, given that the land is municipal owned. In this case as in many others, the complete lack of public participation in local decision-making, a problem that crops up again and again across rural Spain, led to conflict and protests further down the line. The upside is that this experience has produced very active local movements, who keep the public informed and try to involve it in decision-making on future projects.

3.4.2 The Plains: An Area with a Large Capacity to House Energy Infrastructures

In view of increasing public opposition to further developments in the mountains and the declaration of new protected areas in which deployment was impossible, wind power developers turned their attention towards the inland plains where a second phase of expansion took place. The reduced environmental impact, in the sense that there are many fewer protected areas, greatly simplifies the bureaucratic formalities required for installation, and although there is a higher population density than in mountain areas, there has been less local opposition. These circumstances have made the plains that are most exposed to strong, frequent winds into landscapes that are 'susceptible' to be transformed based on the argument that they have a high capacity to house wind power projects and infrastructures.

A special case in Spain is that of the Ebro Valley and in particular two horizontal platforms that stand over 300 m above the bed of the valley. The high plains of La Muela and La Plana are about 20 km away from Zaragoza, one of Spain's most important inland cities, in one of its most dynamic *economic corridors*. One of the first wind parks in Spain was built here at La Muela, and during the last decade of the twentieth century, the installed capacity increased rapidly to over 100 MW. Technological advances have enabled the power produced by each turbine to be increased, so improving their performance. In this way in 2004, the installed wind energy capacity in the two platforms (with an area of barely 100 km^2) totalled 400 MW, a similar amount to that in the whole of France at that time.

The La Muela-La Plana development has a number of distinguishing features that set it apart from other wind parks: it developed earlier than in other places, its current high concentration of turbines and the swift urban development in the area. The lack of opposition to the visual impact of over 500 wind turbines was due to two key factors: the mundaneness of the landscapes of La Muela-La Plana, bereft of any special natural and historical values, and the absence of any public participation in the administrative process in which these projects were given the go-ahead. During the process of administrative authorisation of the wind parks in La Muela, the possibility of public consultation was not considered, and no links were established between developers, councils and local citizens. The lack of information and the nonexistent participation of local people led to the sidelining of 'everyday landscapes', the landscapes that are really experienced by local inhabitants in their daily lives (Nadaï et al. 2010). As in most Spanish regions, there is no landscape culture or government, there is still very little opposition to its transformation and only from very specific areas such as conservationist associations critical of the way wind plants have saturated the area, so highlighting something that is very common in Spain's inland plains: the expansion of wind energy has been facilitated by the lack of socio-economic dynamism bordering on a state of lethargy and the general view of the relevant authorities and the local population that the landscape is of little or no value.

At the same time the fact that La Muela-La Plana is so near to the city of Zaragoza led to spectacular urban development in this area. La Muela Town Council made a huge leap from having a 'budget of 1.1 million euros in 1997 to 33 million 12 years later' (Faci 2009), and during the same period, it tripled the amount of land on which building was permitted, which rose to 425,068 m^2. This urban growth combined with the huge expansion in wind energy has brought about a profound transformation of the landscape, without there being any national or regional legislation that regulates the way it is managed.

In any case the fact that wind energy developed so early in this area enabled developers and government bodies to generalise the model of deployment to other flat areas in inland Spain, most of which meet the requirements for efficient development of wind energy free of conflict, namely, installations that are economically viable in the short term, in areas of little environmental value, which do not put other resources at risk. These criteria are not shared by coastal areas.

3.4.3 The Cadiz Coastline

The province of Cadiz is in the south of the Iberian Peninsula in the south-west corner of Andalusia. This province has a huge coastline on two seas, the Mediterranean and Atlantic Ocean, and is also characterised by: (1) a large area of well-preserved natural spaces (especially in the La Janda and Tarifa areas), (2) a broad biodiversity (favoured by the migration of birds across the Straits of Gibraltar), (3) a huge variety of marine species and (4) an important underwater archaeological heritage. All of these values together with a socio-economic structure based mainly on the primary sector (agriculture, livestock and fisheries) and the limitations on development in zones reserved for military use have led to the high sustainability of this area.

In any analysis of renewable energies and of wind energy in particular, the case of the province of Cadiz, and in particular its coastline, deserves special mention as a place in which wind resources are considered exceptional in terms of their abundance and quality. Tarifa was one of the sites chosen for the first trials of wind turbines, which at that time were supported on a lattice structure, similar to that of electricity pylons. It was also the site of the first wind park (Monte Ahumada, with an installed capacity of 2.95 MW). By the year 2000, there were 11 wind parks in this town. In 2010, the province of Cadiz was the leader in wind energy production in Andalusia with a total of 63 wind parks in operation and an installed capacity of 1,237.58 MW, which represented 44 % of the total installed capacity in Andalusia (2,863.71 MW) (Agencia Andaluza de la Energía 2012).

The best sites in Andalusia for wind turbines are on the coast and in particular on the coast of Cadiz (Tarifa and La Janda) and in Cabo de Gata on the East Coast of Almería (although there are no wind turbines in this area because the Plan for the Management and Use (PRUG) of the Natural Park forbids such installations). The availability of a plentiful supply of wind and the lack of specific prohibitions combined with the high-speed shift towards renewable energy over the last decade and the resulting technological improvements have led to the rapid proliferation of these machines along the coast between Tarifa and La Janda, turning these areas into what have been dubbed 'wind landscapes' (de Andrés and Iranzo 2011).

Onshore wind energy has had some detractors due to the high density of wind turbines in some areas (Frolova and Pérez 2011), but today it is generally accepted by the local population. However, the possibility that offshore wind energy deployment could threaten some of the business activities sustaining the local population, such as tourism, fishing and shipping traffic through the Strait of Gibraltar, led to large anti-wind energy groups being set up, who for many years argued that development should be suspended in this area. Pro-wind energy lobbies also appeared in defence of their economic and research interests backed by the energy companies and certain public institutions. The swift development of wind energy along the Cadiz coastline led to a heated debate which amongst other things gave rise in the La Janda area and others to the drawing up of a Wind Resource Organisation Plan, in which the territory was divided into areas that were considered compatible with the deployment of wind turbines, areas that were compatible in certain conditions and areas considered incompatible. The plan also obliged developers to reach agreement amongst themselves regarding the territorial planning of wind parks in the programming sectors into which these plans were divided and to share the electricity substations and transmission lines until a joint installed capacity of 50 MW was reached. The original intention was to include in these plans the landscape criteria established by the team of experts and the different public bodies. However, they came up against two fundamental problems: the fact that technological advances meant that 50 MW could be produced by a single plant in a short time and the fact that the plans were drawn up with almost no consultation of the local population due to the absence of participation processes. 3D models were used to analyse the impact of the wind turbines on the most significant landscapes, but the most representative local stakeholders were not informed systematically about these models, which were only used in the meetings between the different government bodies that were implementing this process.

In the interviews and questionnaires conducted amongst the local population, it was observed that different groups of local stakeholders accept renewable energy sources as part of their territory, thereby demonstrating that these machines are now part of the landscape of these coastal areas and part of the local identity. Nonetheless, we also encountered some hostile opinions (which given the first results seem to be in the minority) against further deployment above all from groups who consider that their area has already reached saturation point and that these renewable sources do not bring benefits to the local community and from other groups whose business interests clash or compete with those of wind energy. Local residents are probably already accustomed to the presence of wind power infrastructures in their everyday landscape (the first wind parks were installed 20 years ago), and for tourists too they form part of the local scenery. The economic crisis in recent years and the resulting halt to renewable energy development have altered the concerns of the population, who are now highly receptive to any means of creating wealth and employment. There is also wide opposition to green movements, who in defence of what they claim to be more global interests are trying to put a stop to almost the only business or development projects in the area.

3.5 Conclusions

Environmental concerns aroused by CO_2 emissions and global warming have not been the main factor driving the development of wind energy in Spain, and its impact on the landscape has not hindered its progress either. The spectacular growth in this sector is the product of other interests that have manifested the excellent capacity of Spain's economic agents to respond when provided with a stable and financially stimulating framework in which to operate.

The moratorium introduced by Royal Decree 1/2012 brought a halt to this somewhat disorderly frenzied development, but there is still some way to go to meet the commitments acquired by the government under the EU 2020 renewable energy directive, which sets a target for renewable energies (and wind energy in particular) of 20 % of the total consumption of primary energy in the European Union. The great saturation of onshore installations and the awakening of a territorial awareness mean that the future of wind energy in Spain lies with the repowering (replacing old machines with more efficient new ones) of existing wind parks and the development of offshore wind energy, which has great potential in certain areas.

In any case the result is that windmills are now part of the landscape in numerous Spanish regions. Their deployment has produced new discourses, new social practices and relations, many of which are clearly in their favour. In rural areas with impoverished economies, windmills are often viewed as a source of income for institutions and for local people, as a way of moving the area into the modern economy, presenting an image of clean energy and sustainability to such an extent that in the pioneering areas in which windmills have now been installed for some years, they have become symbols of the local identity.

Nonetheless, the moratorium may lead to a change in the model, as during this time many weaknesses and mistakes in the management of spaces that do not enjoy specific protection have come to light, and public opposition has emerged in certain processes which have had a dramatic impact on the territory (Tarroja i Coscuela 2009). This new questioning of projects that impact upon the landscape is due to the gradual, uneven and varying penetration and assimilation of landscape values and landscape culture in society. These changes also spring from the ratification and entry into force in Spain of the European Landscape Convention and the progressive transfer of its ideas into territorial and sector-based regulations. The ELC with its open, very broad definition of landscape is vital to understanding the need to manage and plan unprotected spaces. In addition, its emphasis on the commitment to establish procedures for public participation and the formulation and application of landscape policies may enable us to overcome the inertia of a modus operandi that excluded directly affected stakeholders from decision-making. The process is still in its infancy. Nonetheless, in its different forms and from different perspectives, the deployment of wind power has helped to create a much-needed, perhaps overdue debate about land use and landscape in Spain.

Acknowledgements The authors are grateful to the Spanish Ministry of Economy and Competitiveness (CSO2011-23670) for supporting this research.

References

Agencia Andaluza de la Energía (2012) Consejería de Economía, Innovación, Ciencia y Empleo, Info-Energía. https://www.agenciaandaluzadelaenergia.es/info-web/principalController. Accessed 15 Dec 2012

Ardillier-Carras F, Balabanian O, de Andrés C (2011) Les nouveaux paysages énergétiques en Espagne. In: Humbert A, Molinero F, Valenzuela M (eds) España en la Unión Europea. Un cuarto de siglo de mutaciones territoriales, Collection de la Casa de Velázquez (121). Casa de Velázquez, Madrid, pp 41–58

de Andrés C, Iranzo E (2011) Desarrollo de las energías renovables y cambios paisajísticos: propuesta de tipología y localización geográfica de los paisajes energéticos en España. In: Gozálvez V, Marco JA (eds) Energía y territorio. Dinámicas y procesos. XIII Congreso de Geógrafos Españoles. AGE CGE UA, Alicante, pp 97–107

Deloitte (2012) Impacto Macroeconómico del Sector Eólico en España, AEE. http://www.aeeolica.org. Accessed 20 Dec 2012

Espejo C, García R (2012) La energía eólica en la producción de electricidad en España. Revista de Geografía Norte Grande 51:115–136

Faci L (2009) Huracán en La Muela. Siglo XXI de Aragón 36:1–6. http://www.sigloxxidearagon.es/36/36_pol.php. Accessed 19 Jan 2013

Frolova M (2010) Los paisajes de la energía eólica: su percepción social y gestión en España. Nimbus: Revista de Climatología, Meteorología y Paisaje 25–26:93–110

Frolova M, Pérez Pérez B (2008) El desarrollo de las energías renovables y el paisaje: algunas bases para la implementación de la Convención Europea del Paisaje en la política energética española. Cuadernos Geográficos de la Universidad de Granada 43:289–309

Frolova M, Pérez Pérez B (2011) New landscape concerns in development of renewable energy projects in South-West Spain. In: Zoran R, Claval P, Agnew J (eds) Landscapes, identities and development. Ashgate Publishing, Farnham, pp 389–401

Fundación para Estudios sobre la Energía (2010) Energías Renovables para la Generación de Electricidad en España. http://www.fundacionenergia.es. Accessed 27 Dec 2012

ICEX (2012) España se mantiene a la vanguardia del sector eólico. http://www.icex.es/icex/cda/controller/pageICEX. Accessed 21 Dec 2012

IDEA (2010) Plan de Acción Nacional de Energías Renovables de España (PANER) 2011–2020. http://www.minetur.gob.es. Accessed 18 Dec 2012

IRENA (2012) 30 Years of policies for wind energy. Lessons from 12 wind energy markets. http://www.irena.org/Publications. Accessed 4 Jan 2013

Möller B (2010) Spatial analyses of emerging and fading wind energy landscapes in Denmark. Land Use Policy 27(2):233–241

Nadaï A, Krauss W, Afonso AI, Dracklé D, Hinkelbein O, Labussière O, Mendes C (2010) El paisaje y la transición energética: Comparando el surgimiento de paisajes de energía eólica en Francia, Alemania y Portugal. Nimbus: Revista de Climatología, Meteorología y Paisaje 25–26:155–174

Nogué J (2008) Paisaje, Territorio y sociedad civil. In: Mateu J, Nieto M (eds) Retorno al Paisaje. EVREN, Valencia, pp 220–241

Tarroja i Coscuela A (2009) La dimensión social del paisaje. In: Busquets J, Cortina A (eds) Gestión del paisaje: manual de protección, gestión y ordenación del paisaje. Ariel, Barcelona, pp 239–251

van der Horst D, Lozada-Ellison LM (2010) Conflictos entre las energías renovables y el paisaje: siete mitos y la propuesta de manejo adaptativo y colaborativo. Nimbus: Revista de Climatología, Meteorología y Paisaje 25–26:231–251

van der Horst D, Toke D (2010) Exploring the landscape of wind farm developments; local area characteristics and planning process outcomes in rural England. Land Use Policy 27(2):214–221

Warren C, Lumsden C, O'Dowd S, Birnie RV (2005) 'Green On Green': public perceptions of wind power in Scotland and Ireland. J Environ Plann Manag 48(6):853–875

Chapter 4
Solar Photovoltaic Power in Spain

Expansion Factors and Emerging Landscapes

Matías Mérida-Rodríguez, Sergio Reyes-Corredera, Santiago Pardo-García, and Belén Zayas-Fernández

Abstract Favourable geographical conditions and firm governmental support have resulted in a strong growth of photovoltaic energy in Spain in the last decade, especially in the period 2007–2008. This has led to an important economic development of this industrial sector and the appearance of many effects in both rural and urban landscapes. Nevertheless, in the last years, the situation of the photovoltaic sector has changed noticeably, as the exponential growth of installations and the arrival of economic crisis have provoked the adoption of more restrictive laws, which have opened a period of stagnation and uncertainty. In contrast with other countries, in Spain, ground-mounted solar PV plants have predominated, transforming many rural environments. Some studies which address the impact of these systems and the social perception about them have appeared recently. They also suggest criteria in order to improve their integration in buildings and landscapes. In this chapter, an overview about the deployment of Spanish photovoltaic sector is offered, as well as about the factors which have caused its rise and fall and the consequences of these processes in the landscape.

Keywords Renewable energy landscapes • Solar PV plants • Spanish photovoltaic laws • Social perception • Urban photovoltaic systems

4.1 Introduction

Spain is a paradigmatic example of the development of solar photovoltaic power both due to its rapid expansion and to its current state of decline. With this in mind, this chapter sets out to reach three goals: to offer an overview of the deployment of this sector in Spain, to systematise the reasons for its rise and subsequent fall and to

M. Mérida-Rodríguez (✉) • S. Reyes-Corredera • S. Pardo-García • B. Zayas-Fernández
Departamento de Geografía, Facultad de Filosofía y Letras, Universidad de Málaga,
Campus de Teatinos, s/n. 29071, Málaga, Spain
e-mail: mmerida@uma.es; sergioreyes@colgeo.org; pardo@uma.es; belenzayas@uma.es

M. Frolova et al. (eds.), *Renewable Energies and European Landscapes*,
DOI 10.1007/978-94-017-9843-3_4

analyse the repercussions that its development has had on the landscape. The chapter is divided into three parts that deal with each of these objectives.

Due to the recent nature of the phenomenon, little research has been done on the development of photovoltaic energy in Spain and even less on its repercussions on the landscape. The characteristics of the development of photovoltaic energy in this country were analysed by Espejo (2004) and more recently by Prados (2010a, b), Ortells and Querol (2011), Espejo (2012) and de la Hoz et al. (2013) and in technical and statistical reports by public bodies (IDEA 2011a) and professional associations (ASIF 2009, 2011). At a regional level, the case of Castilla y León was studied by Baraja and Herrero (2010), while Cañizares (2011) focused on particular areas of Castilla-La Mancha. The consequences for the landscape and for the territory have been analysed together with other renewable energies by Prados et al. (2012) and specifically for the case of photovoltaic energy by Mérida et al. (2010) and Mérida et al. (2012). Meanwhile, research by Caamaño (2009) focused particularly on its development in urban areas and the way it is treated in planning systems (Caamaño et al. 2009). Architectural integration of photovoltaic installations was studied by Martín (2008, 2011), Martín and Fernández (2007) and Lloret et al. (1999). Another group of studies, including those by Tudela and Molina (2006), Frolova and Pérez Pérez (2008), Prados (2010b) and Mérida et al. (2012), addressed the social perception of photovoltaic energy development. Finally, various technical studies have drawn up good practice codes (Comunidad de Madrid 2009).

4.2 Development of Photovoltaic Energy Production in Spain

The solar PV power sector in Spain has been developing at a spectacular rate in recent years, as have other renewable energy sources. The need to reduce Spain's high dependence on fossil fuels, the cost of which had risen alarmingly due to constant price hikes during the years prior to the current economic crisis, made renewable energies, including photovoltaic energy, an increasingly attractive alternative. At the same time, various requirements to reduce CO_2 emissions were established by the European Union and in international agreements on climate change. Specifically, EU Directive 2009/28/EC required member states to be producing 20 % of their energy consumption and 40 % of their electricity from renewable sources by the year 2020. Between 2003 and 2012, the installed photovoltaic power capacity in Spain has multiplied by several digits leaping from 27 MW in 2003 to 4,214 MW in 2011, well above official forecasts of 371 MW in 2010.

This expansion reached its peak in 2007 and 2008 (IDAE 2011a), with an exponential level of growth based on and fuelled by strong economic support from the government, attracting speculative investments that helped create a photovoltaic bubble. In 2008, more capacity was installed in Spain than anywhere else in the world (around 45 % of the global total), and by the end of the year, it had a total installed capacity of 3,300 MW, second only to Germany. Since then, the economic crisis and the new regulations have halted this growth drastically, and Spain's posi-

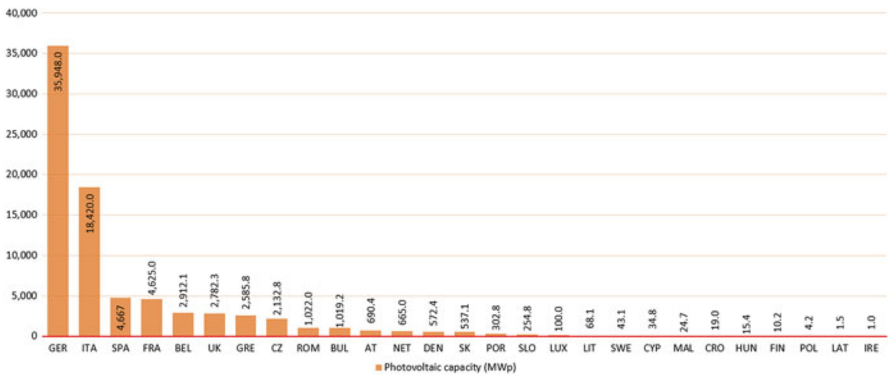

Fig. 4.1 Total installed power in European countries, 2013 (Source: Eurobserv-ER 2014)

tion in the international ranking has fallen back sharply. In 2010, 392 MW were installed, putting Spain in sixth place in Europe, a long way behind the 7,408 MW installed by Germany, and also trailing other countries such as Italy, the Czech Republic, France and Belgium. Total installed power capacity in Spain in 2013 was 4,667 MW, about a quarter of the total in Italy (18,420 MW), while other countries-such as France (4,625 MW) that had been growing quickly in recent years were catching up fast (Eurobserv-ER 2014) (Fig. 4.1).

From the business point of view, the development of the photovoltaic market led to the creation of a buoyant, innovative, new industrial sector, which at its peak employed around 60,000 people, according to the sector's business association, ASIF (*Asociación de la Industria Fotovoltaica*, Photovoltaic Industry Association). However, the impact of the crisis, growing international competition (especially from modules manufactured in China, which has led to a trade conflict with the European Union) and the resulting halt to new projects dealt a severe blow to this industry leading to drastic job cuts, bringing the total down to the current figure of around 7,000 workers. In spite of these problems, Spain still has an important photovoltaic industry. Currently, there are about 40 companies engaged in the manufacture of photovoltaic system components, making it one of the most innovative branches of Spanish industry. The reduction of subsidies in the domestic market in recent years has led these companies to look further afield for business, and they have won contracts in different parts of the world, in which, unlike Spain, photovoltaic energy is currently developing at an intense rapid rate.

Within Spain, most of the installed capacity is concentrated in regions in the centre and south of the country. If we take the figures for 2010 as a reference (ASIF 2011), Castilla-La Mancha had 857 MW, followed by Andalusia (713), Extremadura (464) and Castilla y León (387 MW). In other regions of the country, development has been much slower. In the north of Spain (Basque Country, Asturias, Cantabria, Galicia), this is because the climate is less favourable (fewer hours of sunshine) and in other areas, such as Madrid, because of legal restrictions and competition from other land uses.

Most of this development came in the form of solar PV power plants rather than in roof installations, which accounted for only 2.2 % in 2008 (ASIF 2009). The Spanish model was therefore quite unlike that followed by other countries such as Germany (Prados 2010a), where the proportion of roof-mounted solar PV installations is much higher, at an estimated 40 %. Nonetheless, the clear dominance of ground-mounted PV power plants over roof-mounted systems has made it much more difficult for the industry to adapt to the new scenario created by the economic crisis.

4.3 Factors Contributing to the Expansion of Photovoltaic Energy

There are various factors that have contributed to the development of photovoltaic energy production in Spain. Here, we distinguish between those of a geographic nature and those of a legal and economic nature, which are closely intertwined.

Spain's latitudinal position and its climate conditions mean that it has great potential for the development of solar energy due to the high number of hours of sunshine it receives and the intensity of solar radiation. With the exception of the northern regions, practically all the Iberian Peninsula receives more than 2,000 h of sunshine a year, with the southern half and a large part of the islands receiving more than 2,800. The solar radiation figures are also very high, over 3.5 kWh/m^2 in almost all the country except for the northern flank and over 4.5 kWh/m^2 in the south-east of the Peninsula and in certain areas of its south-western quarter and above all in the Canary Islands (AEMET 2005).

Spain has the additional advantage of having large extensions of free land in which to locate solar installations. On the one hand, it has vast flat or topographically relatively even spaces in particular in the *Meseta of Castile* and also in the large river valleys lying beyond it, such as the Ebro and Guadalquivir valleys, and in the plateau areas of various mountain ranges. An additional advantage is that many of these areas have very low populations at least compared to the national and European averages, in particular in those areas in which renewable energies have reached a certain degree of saturation (Frolova and Pérez Pérez 2008). While the average population density in Spain in 2011 was 93 people/km^2, in most of the country's inland regions, the figure was much lower at less than 30 people/km^2, and there are many large, almost unpopulated areas. By contrast, the most densely populated areas such as the Mediterranean coast and Madrid have almost no photovoltaic energy installations, except logically for those situated on roofs. At the same time, these large open spaces are generally otherwise used for extensive and sometimes marginal farming with low yields per hectare, with the result that those offering new economic alternatives are normally greeted with open arms.

The development of solar PV power in Spain has been shaped to a large extent by the legislative and regulatory framework in position during its different phases.

For this reason, the changes in the regulations have been mirrored by an uneven growth pattern in the installed power capacity. The first national legislation governing the sector was passed at the end of the 1990s. Law 54/1997 (Boletín Oficial del Estado 1997), on the electricity sector, and the Decree of 23 December 1998 (Boletín Oficial del Estado 1998), which implemented it, established a special regime for renewable energy systems by offering production premiums (often known as feed-in tariffs) above market prices and guaranteeing their access to the electricity grid. The Renewable Energies Plan 2000–2010 set a target for 2010 that 12 % of generated power should come from renewable sources, a target that was maintained when the Renewable Energies Plan was revised for the period 2005–2010 (IDAE 2005). A qualitatively importantly leap forward occurred in 2006 when photovoltaic energy was included in the Technical Building Code (TBE) (Boletín Oficial del Estado 2006), which made it obligatory to install photovoltaic systems in certain large buildings with high energy consumption levels.

This first stage, up until 2006, did not have a large direct impact on the growth in this sector, although it did lay the foundations for its subsequent development. It was only later with Royal Decree 436/2004 (Boletín Oficial del Estado 2004), and above all with Royal Decree 661/2007 (Boletín Oficial del Estado 2007), that the government made a firm commitment to boost the growth of this sector by extending the premium system to medium- and large-scale plants. It also guaranteed the future continuity of these subsidies, so eliminating uncertainties and enabling possible investors to estimate the period within which they would recover their initial investment and the subsequent profits they would earn. When this decree came into force, there was an enormous expansion in photovoltaic energy installations, a fact enhanced by the decision, once the ceiling of installed capacity set out in the Renewable Energies Plan 2005 (IDAE 2005) had been reached, to extend for a further year the possibility of bringing new plants into the premium system. In addition to these incentives, the progressive cheapening of the basic materials (solar panels) and their increasing efficiency meant that photovoltaic energy was now a fantastic business opportunity, to the extent that speculative investors also jumped on the bandwagon. If during the year 2007 a capacity of 544 MW was installed (bringing the accumulated total to 690 MW), in 2008 the figure was almost five times higher at 2,707 MW with an accumulated total capacity of 3,397 MW (IDAE 2011a). Until that date, many laws that affected the PV systems had been approved by the different autonomous regions in Spain. The degree of legal complexity developed in each region has proved to be linked with the ratio of implementation of PV on-floor systems in those years (de la Hoz et al. 2013).

This exponential growth (known as the photovoltaic bubble) occurred for purely economic reasons and was not the result of an energy planning process. This led to a corresponding large increase in public spending to pay for the production premiums, just at a time when the first signs of economic crisis were appearing, and within the sector, there were growing concerns about what was known as the 'tariff deficit', i.e. the difference between the high cost of the energy system and the relatively low income it generated. In response to this situation, a new legislative framework was drawn up in Royal Decree 1578/2008 (Boletín Oficial del Estado 2008).

This regulation reduced the premiums and established a procedure of pre-assignation of tariffs for photovoltaic installations, which distinguished between ground-mounted installations (photovoltaic plants) and those installed on roofs; the latter which until then had been in a very small minority would now be prioritised and would receive higher premiums. In order to limit further expansion, annual quotas were established for each type of production, and these were more restrictive for ground-mounted installations. In this context, the government approved the Renewable Energies Plan 2011–2020 (IDAE 2011a), which went further than the objectives set by Directive 2009/28/EC, setting targets for renewable energies for 2020 of 22.7 % of primary energy production and 42.3 % of electricity.

The worsening of the economic crisis has led to the introduction of new laws in which the premiums for photovoltaic installations have been reduced even further. In Royal Decree-Law 14/2010 (Boletín Oficial del Estado 2010), a limit was placed on the number of hours in which photovoltaic plants that received premiums could operate, in accordance with the climate zoning system set out in the TBC (Boletín Oficial del Estado 2006). On similar lines, Royal Decree-Law 1/2012 (Boletín Oficial del Estado 2012) approved the suspension of financial incentives and premiums for the installation of new electricity production plants, including those using renewable energy sources. Finally, Royal Decree-Law 2/2013 (Boletín Oficial del Estado 2013) established new reductions in the system of premiums either by changing the method of calculating them or by removing the option of choosing between the market price and the premium system (Fig. 4.2).

As a result, the photovoltaic sector in Spain is now in a situation of uncertainty and stagnation. The export of technology and the search for contracts abroad have

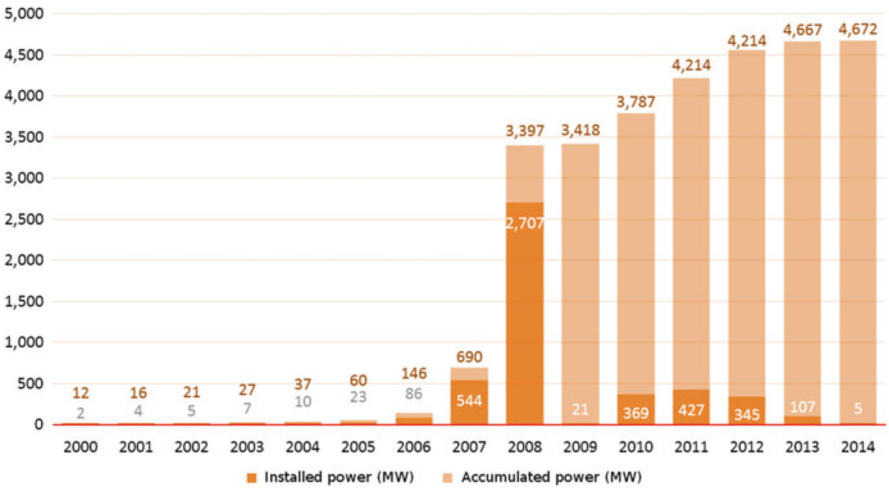

Fig. 4.2 Evolution of the total PV power installed in Spain (2000–2014) (Source: IDAE 2005, 2007, 2011a, b; Red Eléctrica de España, 2015)

so far offered the best solution. While in the domestic market, the only alternative is to develop what is known as 'self-consumption with a net balance', in other words, the option of consuming the energy you produce yourself with the possibility of depositing any excess in the grid and taking it back later when required. This form of production is, however, pending specific regulation. In any case, the cutbacks and the general recession in the sector must be seen as a product of the current economic situation in Spain and of the regulatory and economic mistakes made during its expansion, as in other countries in Europe and indeed throughout the world, the photovoltaic sector is expanding very fast. The reduction in costs and the increased efficiency of photovoltaic systems may help the sector reach grid parity (when a renewable energy source can generate electricity at a levelised cost that is less than or equal to the price of purchasing it from the grid), so enabling it to operate profitably without government subsidies and help the country reduce its dependence on imported energy (IDAE 2011a). Apart from their effects on energy supply in Spain, government spending cuts have had serious effects on a business sector hitherto renowned for its innovative nature and its international projection and one of the few industrial sectors in which Spain has achieved some degree of international leadership.

4.4 Impact on Landscape and Emerging Landscapes

The varied Spanish countryside has witnessed a generalised installation of photovoltaic systems in practically all kinds of landscape. Although the best solar radiation conditions are in the south and west of the Iberian Peninsula, in northern Spain, altitude and exposure factors can be exploited to ensure that acceptable performance levels are achieved (Baraja and Herrero 2010). The transformations that have taken place in rural areas due to the deployment of photovoltaic installations have happened rapidly and spontaneously, independently of territorial planning. This has prevented any analysis of these transformations and any discussion or debate as to possible alternatives for the integration of photovoltaic installations into the rural landscape (Mérida et al. 2012). On the other hand, landscape protection policy has not been a significant obstacle for the deployment of PV on-floor installations, as a study in the region of Catalonia has shown (de la Hoz et al. 2013).

In general, the ideal sites for ground-mounted photovoltaic systems are flat areas or areas with a gentle incline, connected to the main electricity grid. In conceptual terms, this model has been associated with the idea of energy as a crop, in its initial phases in relatively small-scale plants (hence the name *huertos solares* which can be translated as 'solar farms'), a model that is very different from the dominant system in other countries such as Germany, in which there are many more roof-mounted installations. In more rugged, mountainous areas in which access and energy distribution are complicated, small isolated installations predominate, often in association with old traditional buildings in the area.

*4.4.1 Photovoltaic Plants (*Solar Farms*)*

The large number of photovoltaic plants installed has had important effects on the landscape in the areas concerned and has led to the appearance of new landscapes, especially in those areas in which the plants are more densely deployed or in those in which they are combined with other renewables, especially wind power, giving rise to the appearance of what have been dubbed *landscapes of renewable energy* (Mérida et al. 2009). Depending on aspects such as the suitability of their location and the quality and integration in the landscape of their design, these plants can either cause severe negative impacts on the landscape or on the contrary contribute to the recovery of the landscape in certain areas through the improvement of the composition and scenic values.

Although there had been experiments with solar thermal power plants in the province of Almería (south-east Spain) in the 1980s (Espejo 2004), it was not until the following decade that the first ground-mounted solar PV plants appeared in Spain, with pioneering examples such as the plant at La Puebla de Montalbán (Toledo, 1 MWp) (European Commission 2000). In just a few years, these plants became a business success story to which many landowners and investors turned as an investment for the future, encouraged by the incentive system in place at the time, as mentioned earlier.

This type of installation had numerous effects on country landscapes in particular as a result of their unusual (especially in rural areas) design, the large areas that they occupy (Mérida et al. 2010) and the reflective material used in the panels. Government territorial planning instruments have so far proved unable to keep up with the rapid rate of expansion, and no firm criteria have been established that take the impact on the landscape into account. On agricultural land, for example, it has not been necessary to make environmental impact studies when building solar farms, but this has been required in forested areas (Prados 2010a). Many solar farms have a high impact on the territory, as according to studies in Andalusia (Mérida et al. 2010), they are normally situated on flat sites or on hillsides, from which large viewsheds are produced.

The result of all this is a serious, uncontrolled transformation of the traditional rural landscape, in which some agricultural fields have been replaced with large groups of panels, of all the different types on the market, which both in continuous rows and in free-standing, solar trackers are in stark contrast with the area around them. This said, these installations have the advantage of being reversible, in that they can easily be taken down and removed.

The visual impact of solar plants or farms has been studied in detail in recent research (Mérida et al. 2012), and a number of design criteria have been put forward to ensure their improved integration into the landscape. These involve first and foremost carefully selecting the site and minimising the impact of the different component parts of the plant, such as modules, structures, panels, roads, ground, auxiliary buildings, etc. At a more general level, the European project Enerscapes analyses the repercussions of renewable energies, including solar power, on the landscape in different regions of Mediterranean Europe, one of which is Andalusia (ENERSCAPES 2013).

In terms of photovoltaic energy in particular, the main objective of territorial planning must be to correct the situation that arose in recent years in which almost any site and any layout were considered suitable for the installation of a photovoltaic plant, without a thought being given to possible repercussions on the landscape. Another positive step would be to understand the introduction of these installations not only as an impact but also as an opportunity for the rural landscape, as something which with the right measures could even enhance its value. It is therefore important to be aware of the positive social attitude towards these plants which we will be analysing later.

4.4.2 Isolated Photovoltaic Installations in Rural Areas

As has happened in many other countries (Lorenzo 1997), in Spain, photovoltaic solar energy has proved an excellent solution for the electrification of isolated buildings in areas that are far away from power lines. On many occasions, this is done by installing solar panels on the roofs of traditional rural buildings. A good example, due to their size and scope, is the programmes carried out in the region of Catalonia. In one of these programmes, 35 isolated *masías* (traditional Catalonian farmhouses) in the Solsonès area were electrified (Institut Catalá d'Energía 1990). Similar programmes were carried out in the Garrotxa area, in which 65 sites were electrified with a total of 51 kWp (Fig. 4.3).

Isolated systems of this kind have also been constructed in other areas (European Commission 2000), such as the natural parks in Catalonia and in archipelagos such as the Cies Islands off the coast of Galicia. They have also been used as additional electric support for farms, for example, in Jaen (Andalusia). Although there are quite a few cases in the different parts of the country, little research has been done on the landscape impacts of these new installations. In general they look strange and out of place, in a similar way to solar farms, because the materials with which pan-

Fig. 4.3 Solar farm located in the Province of Malaga (Andalusia) (Source: The authors)

els are normally constructed do not usually blend as well with traditional architecture (built of stone, slate, etc.) as with modern buildings. In addition, these houses, normally designed for one family, are small in volume, so heightening the impact on the landscape of the solar panels and complicating their integration still more. The possibilities of using photovoltaic materials that blend in with the building in terms of shape and colour have hardly been explored due to the higher costs they would involve, although this is clearly a field in which more work should be done.

4.4.3 Solar PV Power in Urban Areas

The increase in the area of photovoltaic energy capture on the roofs of buildings has also been important in Spain's cities in recent years. With the most recent changes in legislation, forecasts suggest that the negative trend of the last few years will be reversed, and the solar roof market will be significantly larger than that of ground-mounted installations (ASIF 2011), so bringing the Spanish model into line with that of most of its neighbours.

The introduction of the TBC (Boletín Oficial del Estado 2006), which sets out the criteria that all buildings in Spain must meet, provided a new impetus to the installation of both thermal and solar PV power on the roofs of buildings. It introduced the obligation to install PV power systems on buildings that were above a certain size, as set out in Table 4.1.

The TBC divides the country up into five climate areas on the basis of the average solar radiation they receive. These classifications are used together with the intended use of the building and the floor area to calculate the minimum power that must be installed. The Code also establishes a maintenance plan and maximum loss limits compared to a theoretical optimum system.

The estimated increase in annual production as a result of compliance with the TBC has been calculated. It is estimated that in 2020 this will be around 80 GWh (IDAE 2011b). For their part, the association of manufacturers and installers expects the new European Directive on energy efficiency in buildings to provide a significant boost to the market, as photovoltaic power generation is versatile and can easily be adapted to meet the requirements of this Directive (ASIF 2011).

Table 4.1 Limits set out in the Technical Building Code (TBC) for the installation of photovoltaic panels in buildings in Spain

Type of use	Application limit
Hypermarket	5,000 m^2 floor area
Shopping and leisure centres	3,000 m^2 floor area
Warehouse	10,000 m^2 floor area
Office buildings	4,000 m^2 floor area
Hotels and hostels	100 spaces
Hospitals and private clinics	100 beds
Pavilions in trade fairgrounds	10,000 m^2 floor area

4.4.3.1 City-Level Projects and Ordinances

In addition to the regulations set out in the TBC and those set out in state and regional legislation about energy, each local council has the power to propose its own conditions. In their municipal ordinances, many of them have included the obligation to install solar energy systems. In 2005, a year before the TBC came into force, there were 30 such ordinances referring to solar technology, principally aimed at obtaining hot water and heating (PV UPSCALE 2007).

More recently, some councils have issued ordinances specifically aimed at regulating the construction of photovoltaic installations. Various councils in the island of Gran Canaria, for example, have made it obligatory to install photovoltaic systems in all new buildings, extensions, renovations, refurbishments and changes of use (Ayuntamiento de Las Palmas de Gran Canaria 2009). These regulations also stipulate the minimum power capacity that must be installed for each use and floor area, the maintenance plan and maximum loss limits in a more detailed way than the TBC itself.

Some Spanish cities have taken part in international projects charting the progress of photovoltaic energy in cities. One example is Vitoria, in the Basque Country, which took part in the POLIS (Identification and Mobilisation of Solar Potentials via Local Strategies) project. The aim of this initiative was to encourage the development of solar energy (thermal and photovoltaic) by making it an integral part of town planning strategies (POLIS 2012a). Vitoria has carried out three pilot schemes, aimed at evaluating the solar potential of the city by using digital elevation models (POLIS 2012b). A similar project was executed in the city of Malaga in Andalusia (Ayuntamiento de Malaga 2013). These strategies, which require huge technological input, are fundamental when trying to find the best places to locate urban photovoltaic plants and as a source of detailed information for plant developers and installers.

Another city that has taken an active role in this kind of initiative is Barcelona. The Catalan capital was studied in the PV UPSCALE programme, a European project about city-scale photovoltaic systems, which focuses on areas in which a significant quantity of these plants have already been installed or are planned (PV UPSCALE 2012). Barcelona was praised amongst other things, for its pioneering role in strategies promoting photovoltaic systems, the large number of demonstration installations and the conditions set out in the city's ordinance on solar power, which were stricter than those in the TBC (Caamaño 2009).

4.4.3.2 The Development of Photovoltaic Energy in Buildings and Urban Furniture

In recent years, there has been a great deal of research in this field encouraged to a large extent by the main research centres specialising in this subject (Caamaño et al. 2009). As a result, a number of technical guides have been published, aimed mainly at promoting and improving the integration of photovoltaic systems into buildings

(Martín and Fernández 2007; Martín 2011). The regional governments of Madrid and Andalusia have also produced handbooks of this kind (Comunidad de Madrid 2009; Agencia Andaluza de la Energía 2009). Solar PV power has been integrated into the office buildings of the companies specialising in this market and into numerous recently constructed buildings in which bioclimatic criteria have been taken into account. In 2012, Madrid hosted the Solar Decathlon Europe, an event that seeks to promote the design of efficient buildings by making prototypes (SDEurope 2012).

The truth is that in spite of this research and experimentation, PV power still has a long way to go to become an integrated part of the urban landscape of most Spanish cities. Despite this, Spain already has a long architectural tradition in this field. Specialised bibliography often cites the case of the Pompeu Fabra Library in Mataró (Catalonia), built in 1996, which was one of the first examples of modular facades with photovoltaic panels (Lloret et al. 1999; Martín and Fernández 2007; Roberts and Guariento 2009). In industrial areas, photovoltaic energy is progressively occupying a large number of roofs of industrial units, which often have large exposed surfaces (Martín 2008), although these are normally out of sight of the general public (Fig. 4.4).

In the case of urban furniture, a whole array of different formats have been tried. The most interesting includes the so-called photovoltaic trees and the photovoltaic systems that can be installed on top of pergolas (IDAE 2007). Perhaps the best-known

Fig. 4.4 PV pergola in the venue of Barcelona Forum 2004 (Source: The authors)

example was built on top of the huge pergola structure under which the Barcelona Forum was held in 2004, which had a panel area of 3,410 m^2 that generated 1.3 MWp of electricity, making it the biggest urban photovoltaic plant in Europe (Espejo 2004). The avant-garde design of this pergola gave its solar electricity generation facility an almost monumental character, and it has become one of the icons of the city. It can also be considered a symbol of the current state of urban photovoltaic energy in Spain, which is typically installed in new buildings, often with a symbolic message, while generalised installation in our cities is still a long way off.

4.4.4 Social Perception

Until very recently, there was no tradition in Spain of encouraging public participation in the process of installing renewable energies in its territory. As a result, public opinion has had a very limited role or input into decision making (Frolova and Pérez Pérez 2008). This trend however has gradually been changing due to the concerns of the population regarding the social, ecological and landscape impact of renewable energy installations. Today, public perception of renewable energies is an increasing concern, above all for manufacturers, developers, conservationists and defenders of the landscape and finally for local councils, residents, farmers and landowners, who in general perceive this kind of installation as a positive step to boost economic development in the area (Tudela and Molina 2006). In general, this sector has a positive public image. For many people, wind and photovoltaic solar energy are considered environmentally friendly and are often associated with concepts such as ‘clean’, ‘healthy’, ‘green’ and ‘sustainable’ (Frolova and Pérez Pérez 2008). According to the results of the most recent Eurobarometer, 70 % of Europeans and 81 % of Spaniards consider renewable energies to be the best energy option to promote today (European Commission 2013).

As regards the specific case of photovoltaic plants, the assessment of their landscape impacts was until recently plagued by the absence of specific studies on their social perception (Mérida et al. 2012), due to a large extent to the fact that these installations are relatively new and are still continuing to emerge. For this reason, there is a lack of information about the attitudes and opinions, positive or negative, of the population regarding the undeniable mark these plants leave on the landscape. Some tests and studies have been conducted, however, which enable us to make an initial approach to the analysis of the social perception of these installations.

A case in point was the research conducted by the University of Murcia in the north-east of the region (Tudela and Molina 2006), during the months of May and June 2006, in which local people’s assessment of the photovoltaic plants was studied on the basis of a survey on renewable energy systems. The study revealed that photovoltaic energy was little known (only 9 % of those interviewed said they knew about it) and the general opinion was that it was very expensive, something that applied to renewable energies in general. In this same study, it was also found that this energy was often confused with thermal solar energy and people could not distinguish between the two. Lastly, some of those interviewed shared their concerns about the possible impact of these energy plant installations on the newly emerging rural tourism sector.

Another research paper that explored the perceptions of local people regarding solar photovoltaic and thermoelectric installations was conducted in Andalusia, more specifically in rural areas around the River Guadiamar Protected Landscape (Seville) during the summer of 2009 (Prados 2010b). Based on a sample group of 62 residents of this area, the objective was to assess the transformation of productive agricultural land into large-scale solar plants. Most of those interviewed (78 %) were shown to have an acceptable degree of information about renewable energies. These percentages fell, however, when they were asked to specify the types of renewable energy about which they had information and to list those that were present in their area. Most of those interviewed (60 %) had a positive opinion and thought that the new installations had brought significant changes to the geographical area, environment and landscape.

In another study conducted in Andalusia, social perception of photovoltaic plants was analysed (Mérida et al. 2012). The surveys were performed in 2009, and a sample population was chosen of residents of four villages near photovoltaic installations.

Almost all those interviewed (94 %) said that they had seen the solar farm near their village, while 6 % replied that they had not. A large majority also considered these farms to be positive (63.4 %), while 19.5 % had a negative attitude towards them. Those who viewed the plants positively cited the economic, energy, environmental and employment benefits brought by photovoltaic plants and solar energy. A clear majority (58.5 %) considered that the plants had brought benefits to their areas. Although the concept of photovoltaic energy as something environmentally friendly and associated with values such as progress and innovation undoubtedly has a favourable influence on people's interpretation of the plants' effects on the landscape, in general, those interviewed did not approve of the aesthetics of these installations, which would imply a rejection of their formal contents. Fifty-six percent of those interviewed did not like the sight of solar farms, while 29.2 % considered them attractive (Mérida et al. 2012). Along the same lines, 68.3 % thought that the landscape was more attractive before the installation of the solar farms, and 48 % said that they preferred roof-mounted solar installations, compared to only 29.2 % who thought rural land the best option.

In conclusion, the research done so far in Spain shows a broad public acceptance of renewable energies and in particular of solar PV power due to its positive environmental connotations and the benefits it is perceived to bring to the economic development of the area in which it is located, although concerns were also shown about its high cost. There seems also to be a certain lack of knowledge and wariness regarding photovoltaic energy, largely as a result of its recent arrival on the scene, and a rejection on aesthetic grounds of its formal components (shape, colour) and its industrial nature. A lot of work therefore remains to be done on the design of installations and the selection of suitable sites in order to improve local opinions of these installations (Mérida et al. 2012).

In any case, the aforementioned studies provide specific experiences about particular spaces. It is necessary, therefore, to carry out broader research both in spatial and subject matter terms on the social perception of the development of photovoltaic installations, so as to give us a clearer picture of the degree of acceptance of these installations that will enable us to establish landscape integration parameters for them. Such studies would engage well with the proposed measures for the improvement of the social perception of renewable energies set out in the Renewable Energies Plan 2011–2020 (IDAE 2011a).

4.5 Conclusions

The photovoltaic sector is currently at a crossroads. The existence of favourable natural conditions for its development, generous public subsidies and an important industrial framework combined, until very recently, to give Spain a leading role in the sector at an international level. However, the excessive dependence on public aid and the rapid growth in the number of plants have led, due to their excessive cost in times of crisis, to the sector's current state of paralysis. It is important to emphasise however that the photovoltaic sector makes other significant contributions to Spain's economy, such as reducing its energy dependence, helping it comply with international commitments (climate change, European Union energy strategy) and boosting exports. Its innovative nature (visualised in the development of patents) and even its contribution to the image of Spain as a modern, technologically advanced country must also be borne in mind. In addition, the perspectives for the growth of photovoltaic energy at an international level are excellent, especially amongst emerging countries, which means that if the sector can adapt to this new scenario, ridding itself of all speculative components, it could well have a very promising future.

From the point of view of landscape, the intensity and the speed with which the photovoltaic sector bursts onto the Spanish energy scene explain the almost complete absence of any regulation of its territorial deployment. In general, landscape criteria have played no part either in the choice of sites or in the design of the equipment and installations. It is important to take advantage of the fact that its uncontrolled expansion has now come to a halt to introduce landscape management measures both in rural and urban areas, which will not only lead to the reduction of these impacts but also in certain areas allow plants to be used to enhance the quality of the landscape, so increasing the added value these installations provide. In this sense, the positive social acceptance of photovoltaic energy would be an interesting starting point on which to build. At the same time, the photovoltaic experience should serve as an example on which to reflect about the effects that financial incentives for specific business activities can have on the landscape or territory.

Acknowledgement We are grateful to the Spanish Ministry of the Economy and Competitiveness (Grant Code CSO2011-23670) for funding the translation of this chapter.

References

AEMET – Agencia Española de Meteorología (2005) Atlas de radiación solar de España. Ministerio de Agricultura, Alimentación y Medio Ambiente (Ministry of Agriculture, Food and Environment), Madrid

Agencia Andaluza de la Energía (2009) La incorporación de la energía solar al proyecto arquitectónico. Agencia Andaluza de la Energía, Sevilla

ASIF – Asociación de la Industria Fotovoltaica (2009) Hacia la consolidación de la energía solar fotovoltaica en España: Informe anual 2009. ASIF, Madrid

ASIF – Asociación de la Industria Fotovoltaica (2011) Hacia el crecimiento sostenido de la fotovoltaica en España: Informe anual 2011. ASIF, Madrid

Ayuntamiento de Las Palmas de Gran Canaria (2009) Ordenanza municipal para la incorporación de sistemas de captación y aprovechamiento de energía solar fotovoltaica. Boletín Oficial de la Provincia de las Palmas 127, 7 October 2009

Ayuntamiento de Málaga (2013) Energía solar en Málaga. http://energia.malaga.eu. Accessed 3 Jan 2013

Baraja E, Herrero D (2010) Energías renovables y paisaje en Castilla y León: Estudio de caso. Nimbus 25–26:21–42

Boletín Oficial del Estado (1997) Ley 54/1997, del Sector Energético. In: Boletín Oficial del Estado 285, 28 November 1997

Boletín Oficial del Estado (1998) Real Decreto 2819/1998, por el que se regulan las actividades de transporte y distribución de energía. In: Boletín Oficial del Estado 312, 30 December 1998

Boletín Oficial del Estado (2004) Real Decreto 436/2004, por el que se establece la metodología para la actualización y sistematización del régimen jurídico y económico de la actividad de producción de energía eléctrica en régimen especial. In: Boletín Oficial del Estado 75, 27 March 2004

Boletín Oficial del Estado (2006) Technical Building Code (TBC): basic document HE – energy saving/Código Técnico de la Edificación: Documento Básico HE – Ahorro de Energía. http://www.codigotecnico.org. Accessed 3 Jan 2013

Boletín Oficial del Estado (2007) Real Decreto 661/2007, por el que se regula la actividad de producción de energía eléctrica en régimen especial. In: Boletín Oficial del Estado 126, 26 May 2007

Boletín Oficial del Estado (2008) Real Decreto 1578/2008, de retribución de la actividad de producción de energía eléctrica mediante tecnología solar fotovoltaica para instalaciones posteriores a la fecha límite de mantenimiento de la retribución del Real Decreto 661/2007, de 25 de mayo, para dicha tecnología. In: Boletín Oficial del Estado 234, 26 September 2008

Boletín Oficial del Estado (2010) Real Decreto-Ley 14/2010, por el que se establecen medidas urgentes para la corrección del déficit tarifario del sector eléctrico. In: Boletín Oficial del Estado 312, 24 December 2010

Boletín Oficial del Estado (2012) Real Decreto-Ley 1/2012, por el que se procede a la suspensión de los procedimientos de preasignación de retribución y a la supresión de los incentivos económicos para nuevas instalaciones de producción de energía eléctrica a partir de cogeneración, fuentes de energía renovables y residuos. In: Boletín Oficial del Estado 24, 28 January 2012

Boletín Oficial del Estado (2013) Real Decreto-Ley 2/2013, de medidas urgentes en el sistema eléctrico y en el sector financiero. In: Boletín Oficial del Estado 29, 2 February 2013

Caamaño E (2009) Spain, Catalonia, Barcelona. In: Gaidon B, Kaan H, Munro D (eds) Photovoltaics in the urban environment: lessons learnt from large scale projects. Earthscan, Oxon/New York, pp 71–78

Caamaño E et al (2009) Solar urban planning: the national state of the art in Spain (POLIS project). http://www.polis-solar.eu. Accessed 3 Jan 2013

Cañizares C (2011) Potencialidades territoriales de las energías renovables en Puertollano (Castilla-La Mancha). In: Gozálvez Pérez V, Marco Molina JA (eds) Geografía. Retos ambientales y Territoriales. Asociación de Geográfos Españoles, Madrid, pp 49–60
Comunidad de Madrid (2009) Guía de Integración Solar Fotovoltaica. Fundación de la Energía de la Comunidad de Madrid, Madrid
de la Hoz J, Martín H, Martins B, Matas J, Miret J (2013) Evaluating the impact of the administrative procedure and the landscape policy on grid connected PV systems (GCPVS) on-floor in Spain in the period 2004–2008: to which extent a limiting factor? Energy Policy 63:147–167
ENERSCAPES (2013) ENERSCAPES: territory, landscape and renewable energy. Project site. http://www.enerscapes.eu/. Accessed 11 Sept 2013
Espejo C (2004) La energía solar fotovoltaica en España. Nimbus 13–14:5–31
Espejo C (2012) Energía y territorio: dinámica y procesos. In: Gozálvez Pérez V, Marco Molina JA (eds) Geografía. Retos ambientales y Territoriales. Asociación de Geográfos Españoles, Madrid, pp 69–110
Eurobserv-ER (2014) Photovoltaic barometer. Le journal du photovoltaïque, n° 11
European Commission (2000) Photovoltaic solar energy: best practice stories. WIP, Munich
European Commission (2013) Flash eurobarometer 360. Attitudes of Europeans towards air quality. Brussels
Frolova M, Pérez Pérez B (2008) El desarrollo de las energías renovables y el paisaje. Algunas bases para la implementación del CEP en la política energética española. Cuadernos Geográficos de la Universidad de Granada 43:289–309
IDAE – Instituto para la Diversificación y Ahorro de la Energía (2005) Plan de Energías Renovables en España 2005–2010. IDAE, Madrid
IDAE – Instituto para la Diversificación y Ahorro de la Energía (2007) Energía solar en España 2007: estado actual y perspectivas. IDAE, Madrid
IDAE – Instituto para la Diversificación y Ahorro de la Energía (2011a) Plan de Energías Renovables 2011–2020. IDAE, Madrid
IDAE – Instituto para la Diversificación y Ahorro de la Energía (2011b) Evaluación del potencial de energía solar térmica y fotovoltaica derivado del cumplimiento del CTE. IDAE, Madrid
Institut Català d'Energía (1990) Electrificació rural fotovoltaica. EnergíaDemo 6
Lloret A, Andreu J, Merten J, Puigdollers J, Aceves O, Sabata L, Chantant M, Eicker U (1999) Large grid-connected hybrid PV system integrated in a public building. Prog Photovolt 6(6):453–464
Lorenzo E (1997) Photovoltaic rural electrification. Prog Photovolt 5:3–27
Martín N (2008) La fotovoltaica integrada en el entorno industrial. Energía: Ingeniería energética y medioambiental 207:100–104
Martín N (2011) Integración de la Energía Fotovoltaica en los edificios. Progensa, Sevilla
Martín N, Fernández I (2007) La envolvente fotovoltaica en la arquitectura: criterios de diseño y aplicaciones. Reverté, Barcelona
Mérida M, Pérez B, Lobón R, Frolova M (2009) Hacia la caracterización del paisaje de energías renovables. In: Pillet F, Cañizares MC, Ruiz A (eds) Geografía, Territorio y Paisaje. El estado de la Cuestión. Asociación de Geógrafos Españoles, Madrid
Mérida M, Lobón R, Perles MJ (2010) Las plantas fotovoltaicas en el paisaje. Tipificación de impactos y directrices de integración paisajística. Nimbus 25–26:129–154
Mérida M, Lobón R, Perles MJ, Zayas B, Reyes S, Cantarero FJ (2012) Paisajes Solares: integración paisajística de plantas fotovoltaicas en Andalucía. Consejería de Obras Públicas y Vivienda, Sevilla
Ortells Chabrera V, Querol Gómez A (2011) Burbuja inmobiliaria versus expansión fotovoltaica. Análisis comparado en España 2002–2009. In: Gozálvez Pérez V, Marco Molina JA (eds) Geografía. Retos ambientales y Territoriales. Asociación de Geográfos Españoles, Madrid, pp 301–310
POLIS – Identification and mobilisation of Solar POtentials via Local strategies (2012a) POLIS Project web page. http://www.polis-solar.eu. Accessed 3 Jan 2013

POLIS – Identification and mobilisation of Solar POtentials via Local strategies (2012b) Work Package 4 Deliverable no 10: review of one of pilot action per city
Prados MJ (2010a) Renewable energy policy and landscape management in Andalusia, Spain: the facts. Energy Policy 38:6900–6909
Prados MJ (2010b) ¿Energías renovables o agricultura? Un análisis de la percepción ciudadana sobre los huertos y latifundios solares en Andalucía. Nimbus 25–26:205–229
Prados MJ, Baraja E, Frolova M, Espejo C (2012) Integración paisajística y territorial de las energías renovables. Ciudad y Territorio XLIV(171):127–143
PV UPSCALE (2007) The Spanish planning process. http://www.pvupscale.org. Accessed 3 Jan 2013
PV UPSCALE (2012) Urban scale photovoltaic systems European project. http://www.pvupscale.org. Accessed 3 Jan 2013
Red Eléctrica de España (2015) Series estadísticas del sistema eléctrico español (Statistical data about the Spanish Electrical System). Retrieved from http://www.ree.es/es/publicaciones/indicadores-y-datos-estadisticos/seriesestadisticas
Roberts S, Guariento N (2009) Building integrated photovoltaics: a handbook. Birkhäuser, Basel
SDEurope (2012) Solar Decathlon Europe. http://www.sdeurope.org. Accessed 3 Jan 2013
Tudela ML and Molina J (2006) La percepción social de las energías renovables a través de una encuesta de opinión. Un caso práctico en localidades del noroeste murciano. Papeles de Geografía 44:141–152

Chapter 5
Wind Power Landscapes in France: Landscape and Energy Decentralization

Olivier Labussière and Alain Nadaï

Abstract In 2000, at the dawn of the adoption of the EU Directive on renewable energy, a green-red alliance opened a political window for the emergence of a genuine wind power policy in France. Yet today, after more than 10 years of one of the highest feed-in tariffs in the world, the installed capacity in France is still low. Wind power, if it is to be developed at any significant level, has to fight against the centralization of both French energy policy and landscape protection. In this context, the landscape processes, which take place when wind power is either planned or sited at the local level through open governance, are places and occasions for institutional and social innovation that contribute to building decentralization. This chapter examines the ways in which wind power development has raised tensions over the centralization of both energy and landscape policy in France.

Keywords Wind power development • Landscape policy • Energy policy • Decentralization • France

5.1 Introduction

The Kyoto process and the works of the Intergovernmental Panel on Climate Change (IPCC) have progressively made the world aware of the fact of anthropogenic global warming with its likely major economic and social consequences (GIEC 2007).

This work was carried out with the financial support of the Conseil Français de l'Energie, the French Ministry for the Environment (MEDAD – Program PDD "Paysage et Développement Durable"), the French Agency for the Environment and the Energy (ADEME, convention n° 07 10 C 0019), the Region Ile-de-France (R2DS), and the Energy Interdisciplinary Program of the CNRS.

O. Labussière (✉)
IGA – Institut de Géographie Alpine – Laboratoire PACTE,
14 bis avenue Marie Reynoard, 38100 Grenoble, France
e-mail: olivier.labussiere@ujf-grenoble.fr

A. Nadaï
CIRED-CNRS (Centre International de Recherche sur l'Environnement
et le Développement), 45 bis, avenue de la Belle Gabrielle, F-94736
Nogent-sur-Marne CEDEX, France
e-mail: nadai@centre-cired.fr

M. Frolova et al. (eds.), *Renewable Energies and European Landscapes*,
DOI 10.1007/978-94-017-9843-3_5

Business as usual and adaptation scenarios are numerous and debated. However, all of this points to key trends, including the necessity of limiting growth in energy demand and of diversifying the energy mix (EREC and Greenpeace 2007; AIE 2007, 2008). The development of renewable energies is supposed to be part of this diversification.

Because of their decentralized nature, these energies (wind, solar, marine energy, biofuels) generate multiple and perceptible links to energy resources. They induce a recomposition of the socio-technical link to these resources. They contribute to raising awareness of the consequences of our energy demand, including its impact on the environment. They face policy makers with energy and spatial issues, calling for reconsideration of our relation to landscape.

Wind power policy is a case in point. Because of their scale and physical presence, wind turbines generate considerable landscape transformations, which invite us to reconsider the ways in which we experience and represent landscapes. The detailed examination of planning and/or siting processes of new energies introduces a better understanding of the social processes that underlay the emergence of new "energy landscapes." It also casts a new light on the ongoing liberalization of the energy sector in the European Union, which frames renewable energy policies in the different member states.

This paper focuses on landscape mutations in France and on their link to the liberalization of the energy sector. We argue that, in France, wind power development faces policy makers with the issue of decentralizing both energy policy and landscape policy. The paper proceeds in three steps. First we analyze the recent development of French wind power policy and point to the difficulty for French institutions of transferring decision power regarding the approval of wind power projects and their spatial planning from state to non-state actors and from the center to the periphery (decentralization) (Sect. 5.2). We then turn to examining landscape as a key dimension of all wind power projects. We discuss the capacity of the French administrative tradition of landscapes protection – a formal, visual, and centralized tradition, which we call the "State landscape" – to regulate the development and the presence of wind power in the landscape (Sect. 5.3). Finally, based on the results of two case studies, we show that the ongoing energy decentralization in France, however uncertain it may be, calls for a decentralization of the policy of landscape protection (Sect. 5.4).

5.2 Wind Power and Energy Decentralization

Since the end of the 1990s, the European Union has provided energy and climate policies with an unprecedented regulatory basis. Within nearly a decade, a set of directives and texts – White Paper (UE 1997), European Climate Change Program (UE 2000b), Renewable Electricity Directive (UE 2001), Biofuels Directive (UE 2003), Renewable Energy Directive (UE 2009a), and Third Energy Package "3 ×20" – have punctuated a progressive transition from voluntary targets and a sectorial approach to renewable energy provision (i.e., electricity, biofuels) toward compulsory requirements and a more integrated approach (e.g., renewable energies, energy demand). In this process, the link between energy and climate policy has grown stronger. Energy policies have also been articulated with a territorial dimension, as illustrated by the action plan model attached to the 2009 Renewable Energy Directive (UE 2009b).

In gradually implementing this regulatory framework, France has profoundly modified its energy sector. It unbundled its former monopoly and separated electricity production from grid management activities (creation of the Réseau de Transport d'Electricité – RTE). It initiated a diversification of its electricity mix by adopting a feed-in tariffs for renewable electricity (FR 2000), reforming its energy policy programming law (POPE law) (FR 2005, 2009a, b) and establishing the Grenelle Environment Forum (COMOP 2007; FR 2008, 2009c, d). These changes resulted in a twofold increase in the production of the renewable energies (continuing wind power, supporting solar PV, and creating new incentives for biomass). This development of renewable energies was supported by "sectorial" energy policies (feed-in tariffs for wind power, then solar) and progressively integrated into a purported process of "high environmental quality." These developments marked a cultural shift regarding a kind of management that was traditionally centralized and organized around the choice of nuclear energy. To that extent, they reflect the gradual emergence of a decentralized energy policy and raise the issue of its territorial governance.

The conditions under which of French wind power policy has emerged since the mid-1990s demonstrate the influence of decentralization issues. After some years of trifling wind power development under a system of public tenders ("Eole 2005" 1995–2000), France has gradually changed its national policy framework for feed-in tariffs (December 2000) (FR 2000) and wind power development zones (adoption July 2005, applicable July 2007) (FR 2005). This new framework paved the way for the progressive takeoff of wind power in France. In 2012, the national installed capacity amounted to 4.6 GW. But the adoption of this policy framework triggered a genuine controversy. During the parliamentary debate leading to the adoption of the French Energy Policy Programming Law (POPE), wind power, whose contribution to the French energy mix was infinitesimal, suddenly became a national issue and the object of real debate. National media pointed to "éolicide" (literally "wind power eradicating") amendments. Landscape issues and local opposition were invoked in order to justify the need for State coordination. Detailed analysis of this debate, however, shows that the political battle was fought over the decentralization of the French energy policy (Nadaï 2007a, b): who in the central government, the regions, the departments or the municipalities[1] could or should allow the installation

[1] The French levels of governance do not overlap with the ones usually covered by English terminology. For the sake of simplicity, we use a terminology based on an international description of the French administrative organization (OECD 2006): community or municipality(ies) refers to the French "commune" or "municipalité," an entity more or less corresponding to the English parish or local government, albeit it is not a governmental administration in France (their elected

of wind farms? The battle was fought by manipulating a set of regulatory variables such as the size of wind power parks (through power threshold for the benefit of fixed tariff), the institutional allocation of decision-making power (state or non-state institutions), the territorial scale for decision-making (national, regional, departmental, or local), and the public control over wind power development (e.g., veto or consultative power of local commissions and height/power trigger thresholds for the study of impact and public inquiries). Two parliamentary readings failed to reconcile the diverging viewpoints. The successive proposals ranged from full delegation of wind power policy to local municipalities (full decentralization) to central State control through rational planning tools (full centralization). A joint committee ensued and developed a compromise. The new device, wind power development zones (WPDZs), allowed municipalities and/or intercommunalities to join together and devise zones in which they thought wind farms could be developed. WPDZ should be submitted for administrative authorization to the local representative of the State: the department prefect. Wind farms located in approved WPDZ could benefit from the fixed tariff.

In principle, WPDZ aimed at offsetting the lack of planning framework that had existed since the adoption of feed-in tariffs (in 2000). They aimed at renewing the territorialization of wind farms. Their devising should take into account issues of connection to the grid, environment, and landscape. They appear as a device open to non-state actors, which increases the chances to take local and territorial issues into account. Unlike the German or Danish wind power zones, however, French WPDZ are not planning zones per se but electric contracts that then become planning incentives. They are not translated into urban planning documents (a process which would have involved town councils), and wind power projects do not have to be located in a WPDZ in order to be granted a construction permit: only tariff benefit is conditional to siting in a WPDZ. As such, the WPDZs look like a French exception, evidence of a thwarted decentralization and a decentering of energy policy that is symptomatic of the ambivalence found in French political circles and institutions when it comes to the development of (decentralized) renewable energies.

The actual time lag between the adoption of the feed-in tariff (2000) and the implementation of the first WPDZ (2007) implied a "backward planning process" symptomatic of the difficulty besetting French politics with respect to decentralizing the wind power policy and managing the politicization of wind power. Between 2000 and 2007, the task was extremely difficult for local state services, local authorities, and local populations: very few turbines were installed in the country, and the feed-in tariff was being implemented in the absence of any planning framework.

---

representatives are mayors or local councilors); "intercommunality(ies)" to a group of communities structured as a territorial entity so as jointly to organize public services such as waste management, public transportation, etc.; "department" to the French "département," a subregional administrative division; "region" to the French "région"; "central/national government or State" to the central administration; and "ministerial fields services" to the regional offices of departments/ministries (region and department prefects are local representatives of the State).

Developers prospected rural communities in search of windy sites and the agreement of mayors or farmers in exchange for promises of financial returns (wind power tax, property incomes). Local state services were at a loss to regulate the rising number of project proposals. The French government continued to announce rising national wind power objectives to the European Union, but developed only very gradually siting or planning tools, such as building permits, impact studies, or good practices. These tools supported local state services in project appraisal, but they did not really help to address issues of territorial planning and local politics. Over the period 2000–2007, in the absence of a national doctrine, local state services (DDE, DIREN, DRIRE, SDAP[2]) started to take the initiative. Many of them formed ad hoc inter-administrative platforms in order to face collectively the wave of projects submitted for administrative approval. They began to experiment. This included the devising of wind power plans aimed at regulating the territorial distribution of wind farms. About 46 of these were developed over this period by regions, departments, and other territorial entities. They mainly took the form of standard sieve mapping exercises. The zoning approach prevailed, derived from the accumulation of regulatory constraints (protected landscapes, heritage, flora and fauna issues, co-visibility with axis of transit). The resulting maps targeted wind power development toward less protected and allegedly less qualified areas, without implementing any coherent principle of densification.

In 2007, as WPDZ came into force, a large number of wind farms were already installed. As a consequence, many WPDZ were just “project WPDZ”: they consisted in recycling impact studies that had been devised for project development without any planning dimension.

In the French context, the difficulty in decentralizing energy policy has led to a backward process: feed-in tariffs were implemented before any planning framework was adopted. In the interval, in the absence of clear national framework, local administrations and communities have had to find their own approach to wind power planning.

5.3 Wind Power and the Landscape Process

To a certain extent, the process of developing a wind farm is akin to a landscape process. A wind power project takes place in a site; the materiality and the scale of wind turbines become part of the landscape and raise the question of the becoming of this landscape. Wind power thus becomes a prism through which the landscape is reinterpreted. Often the development of a wind power project triggers collective mobilization. Landscape emerges as a public concern and a shared issue, notably when debating the siting of the project. In this process, landscape is a category that

[2] The departmental service of infrastructures; the Regional Environmental Field Service (DIREN); the Regional Industry, Research and Environment service (DRIRE); and the Departmental Service of Architecture and Heritage (SDAP), respectively.

also allows the parties to debate about shared values and local or regional identity. In France, such a debate also addresses the capacity of the French state to endorse the mission of protecting the national heritage.

The French context is characterized by a strong tension with regard to landscape issues. The debate on landscape was reopened during the 1980s. It was nurtured during the 1980s and 1990s by interdisciplinary forums, including philosophers, senior officials, and social scientists (Chabason 1995; Dagognet et al. 1982). These forums pointed out the lack of coherence between economic development and land planning. At a time when environmental issues were coming to the forefront and French environmental policy was emerging, they argued for a genuine landscape approach and policy, distinct from environmental policy. Environment, they argued, is a natural asset, relevant to protection policy. In distinction to environment, landscape is a cultural asset, emerging in artistic representations of the land (Roger 1997). While historically the vedutas were the first representations of landscape, artistic representations were the origin of its force and evolution. Hence, landscape should not be subjected to preservation.

Later, critics pointed out the limits of anchoring landscape in cultural representation and separating it from the land and the environment (Berque 2005; Dewitte 2001; Hirsch and O'Hanlon 1995; Nadaï 2007a, b). They gradually focused on the political dimension of landscape, seen as a collective project and process. They directed attention to the practices that underlay the production of landscape and their tensive relation with heritage and protection practices (Trom 1996; Besse 2001; Dewarrat et al. 2003; Nadaï 2005; Pousin 2001). This shift from protection to project has become a key issue, both practical and political, with France joining the European Landscape Convention or ELC (UE 2000a). The ELC places the emphasis on everyday landscapes and on a more opened governance of heritage policies; it introduces management and development issues at the heart of landscape policies. Termed "the just landscape" by some analysts, the ELC is seen as an innovative paradigm for landscape policies, which develops the dominant normative approach to landscape toward a more collective management of landscapes (Olwig 2007). In some ways, wind power development provides a testing ground for such views. It calls for evolving the administrative tradition of landscape protection toward a project approach. The French circular which aimed at implementing WPDZ (FR 2006), albeit very general in its guidelines, referred clearly to the ELC and the Aarhus Convention on information and citizen participation.

In practice, however, French wind power policy had to be articulated with a tradition of landscape protection that dates back to the early twentieth century and is deeply rooted in monument heritage. This tradition emphasizes the visual dimension of the landscape and does not easily lend itself to development in the direction of more open governance. Three concepts are at its foundation: "heritage" (i.e., sites and monuments considered as being part of the national "common good"), "co-visibilities" (i.e., the visibility of a project from a monument or a protected site), and "surroundings" (i.e., objectified through a geometric zoning, the surroundings conveys the idea that the subjective perception of a monument is dependent on its nearby environment, which must be protected). This tradition constitutes the basis for what could be called a "state landscape," that is, an institutional form of landscape objectification which has expanded since the 1970s through a diffuse body of laws in the areas of environment, architecture, and urbanism. This development has led to successive implementations of the notion of surroundings through public easements. The regulatory definition of these different zonings (e.g., ZPPAU, ZPPAUP) has progressively evolved from normative protection to a broader governance and process approach (e.g., specifications, public inquiry, project, and development approach).

Despite this evolution, the legislative package put the emphasis on the visual dimension of the landscape. Landscape concerns are translated as visual relations. Visual relations are formally translated through geometric representation (e.g., zoning, easements) in a 2D space: the plan. This chain of translations paves the way for a governance of landscape concerns that relies on a geometric encoding of sight. In the plan, geometric lines are endowed with the weight of law. They divide space and create subareas in which specific administrative field services, such as the ones in charge of heritage and landscape, are vested with a power of veto in permitting proceedings. When it does not translate into a formal power of veto, this state perspective on the landscape leans on the notion of co-visibility in order to objectify the surroundings and bring it into existence as part of the landscape: "It is a matter of sight. From the monument, we look at what's happening around it, and from the surroundings, we look at what's happening to the monument; it works together…a jewel and its case." The translation of this visual approach into a plan is fundamentally concentric: perimeters, circles, or radiuses take heritage elements as their point of origin. The plan aims at endowing a visual geometry with the power to ground administrative decisions about landscape protection: "we see or we don't see." The geometry on which decisions are based, however, acquires political relevance only if it fits the specific situation it is supposed to translate and regulate.

This "state landscape" that consists of numerous concentric figures expresses the state's normative power. It is recomposed by the emergence of wind power, because wind turbines give rise to far-reaching co-visibilities with numerous heritage elements and connect these concentric figures. As a result, the process of decentralization induced by wind power development and thwarted in the arena of energy policy finds a new testing ground for governance of the landscape. In other words, France cannot jointly support landscape policy and wind power policy without challenging the former because of the new visual relations generated by the latter.

5.4 Energy Decentralization and Landscape Decentralization

The issues raised by the development of wind power highlight the necessity to envision more positively the creation of new landscapes. In order to do so, the French tradition of landscape protection, centered in the management of impacts, should move toward a project approach. Landscape governance should not remain restricted to the management of the physical dimension of the space, but should look for ways of sustaining the necessary social changes that underlie the composition of shared wind power landscapes.

As witnessed by local case studies, the situation became critical in the period between the adoption of feed-in tariffs (June 2001) and the first WPDZ (July 2007) when no alternative to the “state landscape” was proposed. Many French departments developed their own wind power plan. They proceeded through trial and error, sometimes in conjunction with the implementation of WPDZ. Some cases of an innovative planning approach provided a framework within which new practices and ways of representing the landscape emerged, as in the Narbonnaise, the Aveyron, and the Eure-et-Loir (Nadaï and Labussière 2009, 2010, 2013, 2015).

These case studies illustrate the capacity of planning processes to put on hold the administrative zonings and the visual norms in order to devise new landscape categories, consistent with natural entities and more reflective of the ways in which daily landscapes are perceived and practiced (Nadaï 2009; Labussière 2010). These developments certainly create tensions, but they are illustrative of decentralization in the making. In the following, we develop two of illustrations.

5.4.1 Shifting from the Cathedral to Wind Power Landscapes

The first case study deals with wind power development in the Eure-et-Loir (Nadaï and Labussière 2015). This department is characterized by the presence of open fields, Chartres Cathedral, and one of the largest installed wind power capacities in France (444 MW approved in 2007, 705 MW in 2013). This case study shows how the presence of wind power can profoundly challenge a visual tradition of landscape protection and induce civil servants to revise their approach to landscape, potentially opening it to the creation of new aesthetic codes.

The land is covered, owned, and managed by industrial farmers. Interviews with various actors in this area bore witness to a conception of wind power as an affair of private business. Wind power projects allegedly (exclusively) concerned land and turbine owners: farmers and private wind power developers. There is no opposition to wind power, even in the most densely equipped areas. In other words, landscape did not seem to raise a public issue, except for the administration.

The French approach to landscape protection has long been centered in and operated from heritage elements and landmarks. In the Eure-et-Loir, this translated into landscape policy mainly remaining concerned with the views from and to Chartres Cathedral, a monument classified as part of the UNESCO world heritage.

In 2005, the first cartographic representation presented the cathedral in the form of geometric cones radiating into the country side and supposed to map areas of visual protection (no wind power development in these cones). In practice, the proliferation of industrial wind turbines generated such a web of far-reaching visual relations in the countryside, and with existing monuments, that traditional landscape protection became unmanageable and forced the administration, so to say, to call it quits with the cathedral and decentralize its viewpoint.

This enticed civil servants to engage in fieldwork so as to develop a situated experience of the presence of the turbine and sharpen a definition of emerging landscape entities. Progressively, the perception of landscape relations and the language of sensation came to relay the traditional "perimeters of visual protection" in the approach to landscape protection. Fieldwork and perceptual experience in the form of a smooth space opened the administration to a relational perspective on the wind power landscape and laid the foundations for new landscape categories (e.g., "traditional" and "wind power" Beauce landscape) and new aesthetic codes.

These categories and codes underlay the devising of a new wind power plan. New cartographic forms such as "wind power basins" and "breathing spaces" were substituted for traditional protection perimeters and testified to the role of new landscape sensations such as visual density and visual relief in the landscape planning approach. This relational perspective on landscape restored the ability of the administration to have a say on wind power development and pursue its mission of preserving the landscape as a public good. Nevertheless, this second-generation plan is not radically innovative, since it still keeps the public at a distance: no public consultation on these new orientations has been undertaken, and the administration is not listening to the particular concerns of the population about the landscape. In this context, the socio-geographical configuration shaped by a market-driven farming seems to be suitable for a capitalistic wind power development model.

5.4.2 *Thinking Like a Massif*

Aveyron (southwest France) is one of the windiest French departments. Wind power development started in Aveyron in 1999. No wind power planning whatever was in place at that time. In order to cope with the increasing number of projects submitted for approval, the local administration decided to set up an interservices platform (in 2000) and start devising a planning scheme. At that time, the Parc Naturel Régional des Grands Causses (PNRGC), a non-state actor, suggested approaching wind power planning on the scale of the "massifs." The suggestion was that massif entities offered a framework that was more compatible with collective action –local mayors could collaborate in planning wind power– and made it possible to better take into account issues of landscape (far-reaching co-visibilities) and proximity. In 2000, the idea was discarded by the prefecture as being too complicated, because massifs overlapped administrative divides. The local administration set aside this territorial approach due to the lack of landscape analysis to objectify the massifs entities.

The outcome was a first wind power planning scheme, issued in 2005. The approach translated wind power issues into zoning through several operations: the definition of landscape "types" based on morphology and heritage values, the mapping of regulatory constraints, and the addition of buffer zones so as to compensate for regulatory insufficiencies in the face of the exceptionally far-reaching co-visibilities imposed by industrial wind turbines. This gradual shift from a qualitative landscape issue to a zoning logic (favorable, unfavorable, or negative) certainly answered to the need of administrative instructors for rationality and objectivity in the face of pressure coming from wind power developers (Nadaï and Labussière 2009).

Inside the favorable zones, the development was left unplanned, and the pressure for project development was not really regulated. As the local administration was not used to communicate figures about projects under consideration (accepted, under acceptance, refused), word of mouth made up for the lack of information. Residents of a hamlet in the massif of Lévezou started to go door-to-door in order to cross-reference information. By doing so, they joined private concerns to a network covering the whole massif, in which they counted more than 200 wind turbines under consideration. In other words, wind power development was reaching a tipping point and compromising the entire Lévezou massif. In order to structure resistance against wind power, the residents created a league ("Levezou in Peril") that tied together threads (heritage, proximity landscape, etc.) which were kept separated by the administration. Thus, local opposition endowed massif entities with a political existence. It politicized massifs in the center and the south of Aveyron in a new relational mode and reconfigured the access to wind power deployment. At the same time, landscape protection was being confronted by the limits of the first wind power plan (e.g., co-visibilities between protected and authorized zones, obsolescence of landscape choices in the face of the rapid technological development of wind energy).

In 2006, WPDZ had just entered into its implementation phase at the national level and provided the local administration with the legitimacy to revise the existing power plan. The Aveyron prefect was replaced. The new prefect imposed a temporary moratorium on wind power permits until all WPDZ would be turned into the administration by intercommunalities. New wind power basins were designed by coordinating the WPDZ processes on the scale of the massifs. Massifs, as landscape entities, were thus endowed with a political and relational existence. They provided an alternative weave, allowing the administration and the local actors to mend the "holes" of the previous plan (i.e., "free" blank zones) and to embroider enlarged wind power zones. This second-generation plan did not fully depart from the initial one but rather took advantage of a new relational approach (i.e., massifs) as a transitional logic geared to more open wind power governance.

The PNRGC supported intercommunalities in this process through funding a landscape architect, provided they conformed to good practices in the devising of WPDZ (e.g., coordination on a massif scale, concerted decision process with local inhabitants). The process, which is still going on, has highlighted the unexpected potential of highlands (former commons used for grazing in the nineteenth century) at the other end of the massifs. The situation of these highlands limits the co-visibilities between the wind farms and the villages. Their status makes it easier for communities to share the financial benefits from wind power. In this way, massifs entities (i.e., relational, concerted, and convenient) illustrate how a planning approach can reactivate inherited socio-geographical configurations so as to foster the emergence of locally shared wind power potential.

5.5 Conclusion

Wind power development raises landscape issues in several European countries (Nadaï and van der Horst 2009, 2010). In the case of France, we have underlined the links between the process of decentralizing energy policy and that of decentralizing landscape policy – both triggered and intertwined by the wind power development.

As Paul Selman (2010) has said in a recent contribution, after railways and industry in the nineteenth and twentieth centuries, energy could become a major factor in the evolution of landscapes in the twenty-first century. The changes brought by the Industrial Revolution occurred on relatively long time scale; cultural changes, including the slow emergence of new aesthetic codes, could take place progressively. By contrast, the climate change imperatively calls for faster and probably just as radical changes in our landscapes. It is therefore necessary to understand these changes in order to translate them into politics.

Wind power is currently the most mature of the new energy technologies. It is certainly part of the energy transition, but its contribution to it is also limited for various reasons (e.g., performance, variability, etc.). This contribution will greatly depend on the collective ability to regulate energy demand. The issues raised by wind power development might be reflective of upcoming challenges in the energy transition. As such, wind power could become a testing ground for our capacity to decentralize landscape and energy governance so as to take better account of the issues that will surely be raised by other new energy technologies.

The technological dream of an "a-social" power generation technology, leaving us untouched and unchanged, resembles the Arcadian landscape: it is a utopia. It does not exempt us from the social and political work necessary to renew our relationship with energy.

References

AIE (2007) Renewables in global energy supply. AIE, Paris

AIE (2008) Energy technology perspectives. Scenarios and strategies to 2050. AIE, Paris

Berque A (2005) De paysage en outre-pays. In: Roger A (ed) La théorie du paysage en France (1974–1994). Champ Vallon, Seyssel, pp 346–360

Besse J-M (2001) Cartographier, construire, inventer: notes pour une épistémologie de la démarche de projet. Carnets du Paysage n°7 7:127–145

Chabason L (1995) Pour une Politique du Paysage (entretien avec Odile Marcel). In: Roger A (ed) La théorie du paysage en France (1974–1994). Champ Vallon, Seyssel, pp 260–272

COMOP (2007) COMOP10, Plan de développement des EnR à haute qualité environnementale, rapport à Borloo J-L. Paris

Dagognet F, Guéry F, Marcel O (eds) (1982) Mort du paysage ? Philosophie et esthétique du paysage. Champ Vallon, Seyssel

Dewarrat J-P, Quincerot R, Weil M, Woeffray B (2003) Paysages ordinaires: de la protection au projet. Mardaga, Sprimont

Dewitte J (2001) Pays paysage: à propos d'une difficulté théorique de l'artialisation. In: Chenet F, Collot M, Saint-Girons B (eds) Le paysage, état des lieux. Ousia, Bruxelles, pp 419–440

EREC, Greenpeace International (2007) Energy [r]evolution. A sustainable global energy outlook. EREC and Greenpeace International, Bruxelles
FR (2000) Loi n°2000-108 du 10 février 2000 relative à la modernisation et au développement du service public de l'électricité. Paris
FR (2005) Loi n° 2005–781 du 13 juillet 2005 de programme fixant les orientations de la politique énergétique, JO n° 163 du 14 juillet 2005:11570
FR (2006) Dispositions relatives à la création des zones de développement de l'éolien terrestre, circulaire du 19 juin 2006, ministère de l'Environnement. Paris
FR (2008) Plan national de développement des énergies renouvelables de la France, ministère de l'Écologie, de l'Énergie, du Développement durable et de l'Aménagement du territoire, 17 novembre 2008. Paris
FR (2009a) Circulaire du 23 mars 2009 relative à la territorialisation de la mise en œuvre du Grenelle de l'environnement. Paris
FR (2009b) Circulaire du 19 mai 2009 relative à la planification du développement de l'énergie éolienne terrestre adressée par la Direction de l'énergie et du climat. Paris
FR (2009c) Loi «Grenelle I» n°2009-967 du 3 août 2009 de programmation relative à la mise en oeuvre du Grenelle de l'environnement. Paris
FR (2009d) Projet de loi «Grenelle II» portant engagement national pour l'environnement, 155, déposé le 12 janvier. Paris
GIEC (2007) Changements climatiques, rapport de synthèse. Genève
Hirsch E, O'Hanlon M (1995) The anthropology of landscape: perspectives on place and space. Clarendon Press, Oxford
Labussière O (2010) Éléments pour une prospective du milieu. L'enjeu du sensible en aménagement. Cahiers de géographie du Québec 54(153):499–515
Nadaï A (2005) Site: La fabrication du paysage. In: Rémy E et al (eds) Espaces, savoirs, incertitudes. Ibis Press, Paris
Nadaï A (2007a) 'Planning', 'siting' and the local acceptance of wind power: some lessons from the French case. Energy Policy 35(5):2715–2726
Nadaï A (2007b) Degré zéro: portée et limites de la théorie de l'artialisation dans la perspective d'une politique du paysage. Cahiers de géographie du Québec 51(144):333–343
Nadaï A (2009) 'Innovative' wind power planning. Plann Theory Pract 10(4):543–547
Nadaï A, Labussière O (2009) Wind power planning in France (Aveyron): from State regulation to local experimentation. Land Use Policy 26(3):744–754
Nadaï A, Labussière O (2010) Birds, turbines and the making of wind power landscape in South France (Aude). Landsc Res 35(2):209–233
Nadaï A, Labussière O (2013) Playing with the line, channeling multiplicity. Windpower planning in the Narbonnaise (France, Aude). Environ Plann D 31(1):116–139
Nadaï A, Labussière O (2015) Planning wind power, re-inventing the visual landscape (Eure-et-Loir, France). Landsc Res 40(1):76–98
Nadaï A, van der Horst D (2009) Wind power planning, landscapes and publics (Guest editorial). Land Use Policy 27(2):181–184
Nadaï A, van der Horst D (2010) Introduction: landscapes of energies (Guest editorial). Landsc Res 35(2):143–155
OECD (2006) Territorial review of France. OECD Publishing, Paris
Olwig K (2007) The practice of landscape 'Conventions' and the just landscape: the case of the European Landscape Convention. Landsc Res 32(5):579–594
Pousin N (2001) Autour du projet : Repère pour un débat. Carnets du Paysage n°7 7:59–63
Roger A (1997) Court traité du paysage. Gallimard, Paris
Selman P (2010) Learning to love the landscapes of carbon-neutrality. Landsc Res 35(2):157–171
Trom D (1996) La production politique du paysage: éléments pour une interprétation des pratiques ordinaires de patrimonialisation de la nature en Allemagne et en France. Thèse de doctorat, Institut d'études politiques de Paris

UE (1997) Commission européenne, Énergie pour l'avenir: les sources d'énergie renouvelables - Livre blanc établissant une stratégie et un plan d'action communautaires, COM (97) 599 du 26.11.1997. Bruxelles
UE (2000a) Conseil de l'Europe, Convention européenne du paysage. Florence, Strasbourg
UE (2000b) Commission Européenne. Communication concernant les politiques et mesures proposées par l'UE pour réduire les émissions de gaz à effet de serre: vers un programme européen sur le changement climatique (PECC)
UE (2001) Commission européenne, Directive 2001/77/CE du Parlement européen et du Conseil du 27 septembre 2001 relative à la promotion de l'électricité produite à partir de sources d'énergie renouvelables sur le marché intérieur de l'électricité. Bruxelles
UE (2003) Commission européenne, Directive 2003/30/CE du Parlement européen et du Conseil du 8 mai 2003 visant à promouvoir l'utilisation des biocarburants ou autres carburants renouvelables dans les transports. Bruxelles
UE (2009a) Commission européenne, Directive 2009/28/CE du Parlement européen et du Conseil du 23 avril 2009 relative à la promotion de l'utilisation de l'énergie produite à partir de sources renouvelables [modifiant et abrogeant les directives 2001/77/CE et 2003/30/CE]. Bruxelles
UE (2009b) Commission européenne, Décision de la commission du 30 juin 2009 établissant un modèle pour les plans d'action nationaux en matière d'énergies renouvelables conformément à la directive 2009/28/CE du Parlement européen et du Conseil. Bruxelles

Chapter 6
Looking Beneath the Landscape of Carbon Neutrality

Contested Agroenergy Landscapes in the Dispersed City

Viviana Ferrario and Matelda Reho

Abstract In recent years, European and national policies have given strong support to renewable energies. The Common Agricultural Policy, in particular, has been pushing farmers to produce renewable energy, both as a contribution to sustainable development and as a way to achieve better economic results. Energy production from biomass, biogas and biofuel produced by farmers – agroenergy – is beginning to produce landscape changes. Despite their apparent contribution to sustainability, these new landscapes can be – and often are – contested. The Veneto region, due to the extreme proximity between agricultural and urban land, is a very interesting area for observing new agroenergy landscapes, opposed by nearby residents. Far from being considered simply as an expression of a selfish NIMBY attitude, local conflicts question both local transformation decisions and the very principle of agroenergy. Their arguments must be taken into account if we intend to design a fairer, more democratic 'landscape of carbon neutrality'.

Keywords Landscape change • Landscape conflict • Agroenergy • Dispersed city • Carbon neutrality • Biogas

6.1 Contested 'Landscapes of Carbon Neutrality'

As a result of increasing awareness of peak oil and climate change, in the last 10 years European societies have focused more on the need to reduce the ecological impact of energy production, in an attempt to comply with the Kyoto Protocol. European and national policies have provided strong backing for renewable

V. Ferrario (✉) • M. Reho
Dipartimento di Culture del Progetto, Università Iuav di Venezia,
Dorsoduro 2196 (Ex Cotonificio), 30123 Venice, Italy
e-mail: viviana.ferrario@iuav.it; matelda.reho@iuav.it

M. Frolova et al. (eds.), *Renewable Energies and European Landscapes*,
DOI 10.1007/978-94-017-9843-3_6

energies. The Common Agricultural Policy in particular has been encouraging farmers to produce renewable energy, both as a contribution to sustainable development and as a way of improving their economic results.

Several kinds of biological products can be produced by farmers and then reused to obtain a renewable energy source such as electricity, fuel and heat: the energy coming from biomass, biogas and biofuel produced by farmers is called agroenergy. In the last years, agroenergy has been presented as a valid solution to both the oil and the energy crises and has been strongly supported by European policies, notably by the CAP.

As with other forms of renewable energy, agroenergy often leads to social conflicts. Some conflicts occur on a global scale, since agroenergy (in particular, biomass and biofuel) may compete with food production for land use (Azar 2003; FAO 2008; Rathmann et al. 2010) and has been accused of pushing up food prices (Rathmann et al. 2010). Other social conflicts arise from the changes produced by agroenergies at a local level. Different effects of agroenergy developments are now becoming visible in several agricultural regions in Europe, transforming crops together with the agricultural landscape.

These changes belong to what Selman convincingly called the 'landscape of carbon neutrality', namely, the new 'type of landscape that might emerge as society finally grasps the nettle of dramatically reducing energy profligacy and dependence on fossil fuels' (Selman 2010: 157). Despite their contribution to energy sustainability, these new landscapes can be – and often are – contested, raising problems of social acceptance all over Europe (among others: Devine-Wright 2005; Nadaï 2007; Wüstenhagen et al. 2007; Kerckow 2007; Wolsink 2007a; Zoellner et al. 2008; Selman 2010).

In this article, we observe the development of some agroenergy landscapes in the Veneto region, an area where the extreme proximity between agricultural and urban land tends to exacerbate the conflict.

Our work seeks to highlight the connection between government policy, landscape transformation and public perceptions, in three steps: we firstly analyse regional policies funding agroenergy development; secondly, we survey in quantitative and qualitative terms the landscape transformations caused by agroenergy development; and thirdly, we analyse one of the most contested new landscapes, that of biogas, in order to explore the reasons behind the conflict in greater depth. As we will see, the unacceptability of biogas seems to be heavily influenced – as observed by Selman – by the negative 'narrative' behind it. Nevertheless, this Negative narratives identifies a real problem: the evident difficulties with policy coordination shown by the public administration, together with the indifference towards territorialisation and landscape transformation, which generate territorial effects often perceived as unfair.[1]

[1] This article was written in the context of wider ongoing research about the relationship between agricultural landscape and urbanisation processes in the central part of the Veneto region, financed by the Università Iuav di Venezia in 2012. Viviana Ferrario wrote paragraphs 6.1, 6.3, 6.5 and 6.6; Matelda Reho wrote paragraphs 6.2 and 6.4. The authors wrote paragraph 6.7 together.

6.2 European Policies, Agroenergies and Their Contradictions

European policies on agroenergy can be viewed in different ways: on the one hand, they represent a synergy between energy policies sustaining renewables[2] and agricultural policies subsidising multifunctionality,[3] and on the other they reveal the extreme difficulty Europe has in coordinating sectoral policies with regional and spatial planning and in evaluating and controlling the consequences of such policies both locally and globally.

In 2009, after 6 years, agroenergy subsidies were abolished by Council Regulation 73/09, and renewable production was regulated by Directive 2009/28/EC 'On the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC'. This coincided with an interesting international debate which has shown that agroenergy is scarcely sustainable. Several weak points have been identified (Reho 2009): the energy balance is not always competitive, it creates competition between energy and food production, its dubious contribution to reducing greenhouse gas emissions, the real cost of renewable production and the new technology it requires, unfair distribution of benefits along the agroenergy chain, connection problems with existing energy grids, conflicts over water use, conflicts over land use, the environmental and landscape impacts and the loss of biodiversity. Directive 2009/28 dealt with only some of these issues, above all in relation to biofuel, which had been at the centre of a heated debate for several years.

Since 2009, biofuels and bioliquids are required to fulfil various sustainability criteria: the reduction of greenhouse gas emissions thanks to the use of biofuels and bioliquids must be at least 35 %; the land should not be converted for the production of biofuels if its carbon stock loss upon conversion could not, within a reasonable period, be compensated by the reduction in greenhouse gas emission resulting from the production of biofuels or bioliquids; biofuel and bioliquids can only qualify for the incentives when it is guaranteed that they do not originate in biodiverse areas.

It is evident that the European Commission only takes one dimension of sustainability into account, namely, the environment, neglecting the economic and social aspects of renewable energy development.[4] This limit is more evident if we consider it together with the effects of policies for diversification in agriculture (e.g., photo-

---

[2] Please see Directive 2001/77/CE on the promotion of electricity produced from renewable energy sources in the internal electricity market, Directive 2003/30/CE on the promotion of the use of biofuels or other renewable fuels for transport, biomass action plan (2005) and EU Strategy for Biofuels (2005).

[3] Agenda 2000 and the Fischler CAP Reform 2003 offer, for example, the possibility of producing biomass in set-aside agricultural surfaces.

[4] On social and economic issues, the European Commission is only obliged to report, every 2 years, 'to the European Parliament and the Council on the impact on social sustainability in the Community and in third countries of increased demand for biofuel, on the impact of Community biofuel policy on the availability of foodstuffs at affordable prices'.

Table 6.1 Types of operations that were supported by the member states in their rural development programmes to increase renewable energy production (2006–2013)

Types of operations	Articles and measures	Potential effects
Biogas production – anaerobic digestion plants using animal waste (on farm and local production)	Article 26: modernisation of agricultural holdings Article 53: diversification into nonagricultural activities	Substitution of fossil fuel, reduction of methane (CH_4)
Perennial energy crops (short rotation coppice and herbaceous grasses)	Article 26: modernisation of agricultural holdings	Substitution of fossil fuels, carbon sequestration, reduction of nitrous oxide (N_2O)
Processing of agricultural/ forest biomass for renewable energy	Article 28: adding value to agricultural and forestry products	Substitution of fossil fuels
Installations/infrastructure for renewable energy using biomass	Article 53: diversification into nonagricultural activities Article 54: support for business creation and development Article 56: basic services for the economy and rural population	

Source: European Commission, DG Agricultural and Rural Development (Council Regulation (EC) n. 1698/2005).

voltaic energy production is considered as agricultural income, despite its potentially severe impact on land use and landscape, not only at a local level) and of policies for rural development. The Common Agricultural Policy in fact, through the regions – as we will see later on – financially supports renewable energy on all axes of its Rural Development Plan in favour of a strategy against climate change (Table 6.1). But what control is there on energy sources and origin and on the compatibility of the locations of new plants?

Despite the fact that regional policy on agroenergy is established within the mandatory contest of the CAP, some variations can be observed due to regional interpretation, expenditure autonomy and a greater or lesser capacity to connect sectoral policies. It is therefore interesting to observe both policies and their effects in specific geographical areas: global policies can produce very diverse effects when they come into contact with local contexts, societies and territories, giving rise to very different local landscapes.

6.3 The Study Area: Landscape Changes, Extreme Demands on Agricultural Land and Coexistence Conflicts

In the last 40 years, the Veneto region has undergone strong urban development, which transformed the fertile central plain into a wide, low-density, metropolitan area. Urbanisation took place in a very dispersed manner, with the result that agriculture has been maintained all over the urbanised territory, in between urban settlements and infrastructures (Fig. 6.1). The general impression is that the Veneto

Fig. 6.1 Everyday agrourban landscape in the central plain

countryside is now a metropolitan area with a still substantial amount of agriculture (Ferrario 2007, 2010), given that according to regional land use data (2006), about 60 % of the central plain, which has a population of two million, is cultivated.

This rural/urban coexistence occurs firstly because despite urban development (and a strong fragmented ownership of farming land), agriculture is still profitable and has good results in terms of quantity and quality of production[5] and secondly

[5] The Veneto region is the number one region in Italy for cattle breeding and one of the most important for maize production. The central plain hosts some well-known high added value products, like, for example, Radicchio di Treviso (red chicory) or Prosecco (sparkling white wine). Despite

because farmland inside the metropolitan area has been preserved from the excessive rationalisation and simplification which elsewhere have caused the loss of the complex system of hedges and trees on field boundaries. In this way, a certain residual ecological value of agricultural space has been preserved inside the urbanised territory.

In this situation – more 'agrourban' than 'urban' – we can observe some ongoing processes that can be summarised as follows:

- New landscapes: due to increasing urbanisation, buildings and infrastructures on the one hand and intensifying agriculture practices on the other, landscape in the central Veneto region is rapidly changing, fuelling a growing social conflict, as we will see below.
- Demands on agricultural space: as the amount of agricultural land diminishes, it becomes increasingly important for closing cycles and to give the Veneto metropolis some hope of sustainability. The demands made on agricultural land for energy, food, biodiversity, leisure and the preservation of cultural heritage are not always easy to reconcile.
- Coexistence conflicts: specialisation exacerbates coexistence problems between activities that used to coexist happily side by side because they were carried out in a compatible way (e.g., factories and farming, factories and living areas, farming and living areas). Here, a huge number of local residents would tell you that they love 'to live in the countryside' (Castiglioni and Ferrario 2008).[6] The agrourban landscape is in deep crisis.

Despite the extreme proximity between urbanised and cultivated spaces, territorial and agricultural policies remain independent of each other. Agricultural policies follow a sectoral logic, as if this were some nondescript rural territory with little or no population.

6.4 Regional Agricultural Policy on Agroenergy

Since the Regional Energy Plan was approved only as recently as 2014 (D.G.R. n. 127/CR) and is far from being implemented, agroenergy policy in the Veneto region has only been regulated in the last few years by more general regional laws and European programmes, such as the Regional Operational Programme (ROP) and the Regional Development Plan (RDP 2000–2006 and 2007–2013).

---

the unfavourable weather patterns in 2012, the agricultural output of the region was five billion euro (+5 %). The number of people working in the sector increased (+11 %), as did the price and the sales of beef and pork (respectively +10 % and +5 %) and the export of food products (+9 %) (www.venetoagricoltura.it).

[6] It is important to underline that people living here are not 'townies': newcomers are normally from other agrourban places nearby.

Regional Law 40/2003 on agroenergies offered financial support to agricultural and industrial businesses to encourage them to invest in (thermal and electrical) energy production from renewable agricultural (biogas and biomass) and agroindustrial sources. The funding comes in the form of grants covering up to 60 % of eligible expenditure.[7] This takes agroenergy production beyond the single-farm dimension and raises a serious problem of raw material supply for energy production.

Over the period of 2000–2006, agroenergy was referred to in various Priority 2 (countryside and rural communities – integrated measures) and Priority 3 (multipurpose agriculture, environment and landscape) Measures, financing mostly wooden biomass production. In the 2007–2013 period, by contrast, more attention has been paid to energy production, financing above all the construction of biomass and biogas plants. Measures in Axis 1 ('to improve the competitiveness of the agricultural and forestry sector') and in Axis 3 ('to enhance the quality of life in rural areas and the diversification of the rural economy') gave increasing funding to farmers for building different kinds of plants within their farms (Measure 121) and larger profits for nonfarmers (Measure 312).[8]

Another policy which had a strong influence on agroenergy was Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources, which was executed by Regional Law 1/2008.[9]

The massive presence of animal husbandry in the Veneto central plain (60 % of the regional nitrogen surplus is concentrated in the provinces of Padova, Vicenza, Treviso) represents a serious problem for water quality in surface and groundwater and in the Venice lagoon (Table 6.2).

Since the nitrogen surplus cannot be distributed in the fields because there is not enough agricultural land, the regional administration tried to solve the problem by financing energy plants powered by livestock biomass.[10] At the regional level, a production of livestock biomass of 2.7 million tons per year was estimated, being

---

[7] Up to 2,000,000 euros for farmers and 6,000,000 euros for industrial companies. Other regional laws supporting and regulating agroenergy production are L.R. 14/2003; L.R. 8/2006; L.R. 5/2011.

[8] Measure 121 financed efficient energy plants with low emission levels with up to 20 % of the admissible expenditure if part of the farm is powered by agroforestry biomass, livestock effluents or photovoltaic energy and up to 40 % for biogas and biomass power plants. Measure 312 financed the creation or development of companies producing energy from local renewable sources. 2013-2020 CAP confirms attention in agroenergy production in priority 5 "promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in the agriculture and food sectors and the forestry sector".

[9] This Directive also allows quantities of manure equivalent to 170 kg of nitrogen per hectare per year in vulnerable areas.

[10] 'L'adozione di particolari tecnologie o sistemi di trattamento degli effluenti zootecnici può contribuire a riequilibrare il rapporto tra carico di bestiame in allevamento e la disponibilità di terreni sui quali effettuare l'utilizzazione agronomica dell'azoto ai fini della fertilizzazione delle colture' (Adoption of particular treatments of zootechnical effluents can contribute to rebalance the ratio between the zootechnical burden on the land and how much land there is to benefit from nitrogen fertilisation) (Regione del Veneto 2009b).

Table 6.2 Location of nitrogen surplus in animal husbandry in Veneto region

Provinces in Veneto region	Animal husbandry in surplus (number)	Utilised agricultural area by animal husbandry in surplus (ha)	Nitrogen in surplus (kg)	Nitrogen produced by animal husbandry in surplus (kg)	UAA (Utilised Agricultural Area) needed by animal husbandry in surplus (ha)		
					Non-vulnerable areas	Vulnerable areas	Average
Belluno	7	22,770.12	1,434,599.88	23,022.46	67.72	135.42	101.57
Padova	1,025	30,408.74	8,943,196.86	4,067,867.63	11,964.31	23,928.64	17,946.47
Rovigo	160	17,540.73	2,890,890.56	1,265,544.75	3,722.19	7,444.38	5,583.29
Treviso	966	27,380.19	7,250,540.03	3,540,086.70	10,412.03	20,824.04	15,618.03
Venezia	211	21,261.22	2,924,420.16	974,941.24	2,867.48	5,734.95	4,301.21
Verona	1,418	53,973.28	23,838,083.70	14,536,949.20	42,755.73	85,511.47	64,133.60
Vicenza	864	40,483.92	9,678,197.18	3,519,443.51	10,351.30	20,702.61	15,526.95
Veneto	4,651	213,818.20	56,959,928.37	27,927,855.51	82,140.76	164,281.51	123,211.12

Source: Regione del Veneto (2009), Dgr 389/2009, Annex A used in 60 new biogas plants of up to 1 MWe and about 12 new industrial plants of up to 5 MWe (Regione del Veneto 2009), considering that plants will digest 35–45 % of livestock effluent and 55–65 % of plant biomass (mostly maize). In 2009 in the Veneto Region, there were only 26 biogas plants in service (both industrial and agricultural), while 23 were in the process of authorisation (Regione del Veneto 2009).

It is important to note that:

- While agricultural plants use livestock effluent and vegetal biomass, industrial plants use the organic fraction of solid urban waste and/or agroindustrial waste.
- The biogas production process does not reduce the total quantity of nitrogen, so all it does is 'displace' the problem.
- Spatial distribution of plants does not always coincide with areas with a nitrogen surplus.

All these policies and economic measures mobilise a huge budget: how is this connected with the inherent territorial characteristics? What are the consequences for the territory? How can agroenergies fit in with the local landscape? What kind of new landscape they generate? How does the population deal with the changes produced by the new plants?

6.5 Agroenergy as a Landscape Problem in the Veneto Region

In the last 10 years, the central plain has been affected by substantial agroenergy development. If until 2007 only few clues could be detected (Ferrario 2007), now the changes to the landscape are more and more visible: people have started noticing them and have begun to take sides, generally against agroenergy and the changes it brings.

The Veneto central plain is a place of high territorial conflict, as witnessed by the increasing number of grassroots movements and protest committees (in Italian '*comitati*'), which doubled between 1998 and 2009 (Varotto 2012). According to Paesaggi Veneti SOS in the provinces of Padova, Treviso, Venezia and Vicenza, corresponding more or less to the central plain, there are 212 'comitati'.[11] They fight against new transport infrastructures and new dumps, quarries and waste incinerator plants or more in general against increasing urban development, loss of

[11] Paesaggi Veneti SOS was an observatory funded in 2007 to collect information about grassroots movements and local protest committees. It used to provide an online map at a regional scale and a database (http://www.paesaggivenetisos.org/sito/comitati.asp, no more existing). In the last 10 years across Italy as a whole, there has been a huge increase in committees protesting against territorial transformation and public works. There were so many committees scattered across the country that the Italian Government, together with the national environmental association Legambiente, decided to set up an observatory (http://www.nimbyforum.it). In 2011, the national observatory surveyed 40 conflicts against public utility works in the Veneto region. Of these, 25 were related to new energy plants.

agricultural and natural landscape and pollution. In the last 5 years, agroenergy in particular has given rise to a wave of conflict.

As previous researchers have noted (Wolsink 2007b; van der Horst 2007), it is too simplistic to dismiss this phenomenon simply as a NIMBY syndrome. It is necessary instead to analyse it in greater depth, not only to understand the conflict itself better but also to learn more about the ongoing process.

The characteristics of new landscapes, in terms of location, number, speed and impact of transformation, are important factors influencing the conflict (van der Horst 2007). In the following paragraphs, we will therefore try to quantify and spatialise agroenergy in the Veneto region and link it to conflict, discussing the reasons behind it.

6.5.1 The Survey

Quantification and spatialisation. Since the phenomenon is very recent and the Veneto region cannot yet provide updated, spatialised data about biomass and biogas plants, wooden biomass plantation and photovoltaic power, we were obliged to survey them ourselves.[12] In addition to the names of the municipalities in which the plants are sited, our survey also enabled us to find out their exact position in the municipality. In principle, their exact location can then be analysed in relationship with the form and the density of the settlement and the dimension and quality of the local infrastructure network. Due to the fact that they continually raise the strongest opposition, we decided to concentrate our analysis on biogas plants. We therefore conducted a site survey of the landscape surrounding every biogas plant on the central plain. This site survey allowed us to gather more information about local conflicts, since protest committees often display their protest signs along the roads (see below). It also included visits to functioning biogas plants and a long informal interview with the president of one of the protest committees, as well as some short occasional conversations with people living in the vicinity of the plants. This survey of the conflicts was completed by mapping protests against biogas plants.[13]

[12] In general, we compared data from an aerial photo interpretation based on Google Earth, from about 2000 to 2012, data from authorization documents published on the Internet by the regional administration (bur.regione.veneto.it), statistical data from the 2010 Agricultural Census (censimentoagricoltura.istat.it), official lists from the national energy authority Gestore Servizi Energetici (GSE) (www.gse.it) – for example, for photovoltaic – and finally sectoral publications (e.g., L'Informatore Agrario, 2008 for biogas).

[13] The data survey about the new agroenergy landscape and related conflicts was started in autumn 2012 and completed in February 2013. Site surveys and interviews were made between January and March 2013. We obtained most of the data on conflicts by consulting regional daily newspapers online or protest committee's websites.

6.5.2 New Agroenergy Landscapes: Biomass, Biofuel, Photovoltaic and Biogas

Trees are important among other things because of their contribution to the ecological network, their phytoremediation properties and their use as *biomass* to produce renewable energy. These three functions were taken into consideration in certain specific agricultural policies that have thrown up new agricultural landscapes over the last few years. The first two functions led to the growth of vegetal buffer zones along the agricultural irrigation and drainage network, integrating the old hedge system alongside normal cultivation with the aim of fixing nitrogen and phytoremediated water. The third function of trees as biomass normally results in short rotation forestry, substituting 'normal' cultivation in certain fields. The farm area officially devoted to wooden biomass increased from 37.76 ha in 2005 to 501.60 ha in 2009 (Veneto Agricoltura 2010a), but the quantities are probably underestimates: according to our survey in the central part of the region alone, in 2013, biomass forests currently occupy a total surface of more than 1,500 ha. Locally, the new biomass landscape is quite well integrated into the existing agricultural landscape and appears as just another kind of crop. At the regional level, however, biomass plantations seem to be located with no regard to the ecological network, as designed by the Regional Spatial Plan. Protests against biomass mostly affect biomass plants (Upreti 2004), rather than tree plantations, and are generally connected to the burning of solid urban waste which these plants are legally permitted to do under certain conditions (Reho 2009).

Biofuel has also expanded fast. For example, the cultivation of oilseed rape for biodiesel in Veneto leapt from 142 ha in 2006 to 3,389 ha in 2010 (Veneto Agricoltura 2010b). While in the past industrial crops were concentrated in the peripheral part of the region and were of less interest in the central part (probably because of the high fertility of its soil and the fact that the plots are normally very small), oilseed crops have also increased substantially in the central plain too. Even though energy crops can contribute to a reduction of greenhouse gas emissions, unselective and unregulated cultivation can have negative effects on the ecosystem, such as soil erosion and nutrient spillovers, and a negative impact on landscape aesthetics (Bastian et al. 2006). Nevertheless in this case too, public rejection is directed against plants rather than plantations.

Ground-mounted photovoltaic energy installed on agricultural land has a relatively homogeneous territorial distribution. About 450 ha of cultivated surface were occupied by photovoltaic plants as of February 2013 (75 ha in the central area). Photovoltaic energy is considered one of the most severe detractors in the landscape, but the problems it generates are not only visual: soil artificialisation, the removal of fertile soil from cultivation, and agronomic simplification (trees and hedges are considered as obstacles) are the best known problems (Prados 2010) and also those most complained about by grassroots movements. A strong national movement against ground-mounted photovoltaic plants has emerged in the last few years, until a National Law (L. 24 March 2012, n. 27) decided that public subsidies for renewable energies could not be given to photovoltaic plants on agricultural land.

Biogas plants have also developed fast.[14] A biogas plant is an anaerobic digester that produces biogas from animal waste or energy crops, to fuel an engine that produces electricity. At a local level, biogas plants produce consistent landscape transformations. They are caused both by the plant itself and by the direct and indirect effects around it. Since biogas plants are allowed to digest both crops and livestock effluent, in principle they can affect up to 300–350 ha per megawatt of installed power, so producing crop change (Riedel 2013). From the crop point of view, biogas has not yet produced significant transformations in the Veneto region, since maize is already the most widely used crop. Nevertheless, if crops and effluents have to be brought in from outside the farm because of the large scale of the plant, their transport to the plant ends up generating heavy traffic.

Moreover, digesters and storage units are huge and highly visible from a long distance[15] and can also affect smellscape and soundscape at a local level. All these negative effects are obviously more intense the closer one gets to the plant.

At present, biogas development is by far the most contested agroenergy-induced transformation in the central part of the region. We have therefore decided to analyse this form of renewable energy in greater depth in order to better understand the quantities involved, the dimension of the conflict and the reasons behind it.

6.6 Contested Biogas Landscapes

As in the case of ground-based photovoltaic plants, the spatial distribution of biogas plants reveals a significant presence in the most densely inhabited central part of the region. The urbanised central plain hosts an increasing number of biogas plants, which have aroused great opposition in the area.[16] Citizen committees against biogas are also concentrated in the central plain (Fig. 6.2).

---

[14] According to EurObserv'ER in 2008, Italy was the third biggest producer of electricity from biogas after the United Kingdom and Germany. The Veneto region is the fifth largest producer in Italy (Veneto Agricoltura 2010a), and 81 % of biogas production is obtained from urban waste. Sources vary as to the total number of agricultural biogas plants in the Veneto region. According to Veneto Agricoltura, in 2008, there were 28 biogas plants in the whole region, 12 of which were on a farm (Zoppelletto 2008), while in the same year, *L'Informatore agrario* reported that there were 17 farm plants. In 2010, there were 33 agricultural plants, while in 2011 the CRPA (Centro Ricerche Produzioni Animali (Italian Research Center for animal production)) national survey found 49 agricultural biogas plants in the Veneto region, with 29 under construction (Fabbri et al. 2011). According to our survey, the Veneto region authorised a total of 112 biogas plants between 2004 and 2013. According to the Energy Regional Plan (2014) the authorized plants in 2011 were 116 (13 authorize in 2007, 14 in 2008, 19 in 2009, 35 in 2010, 35 in 2011; in 2012 16 authorized plants were still inactive).

[15] Biogas plants of 1 MW are normally composed of cylindrical containers with a diameter of 20–30 m and a cone-shaped cover, with a total height of 6–10 m. There are also various other containers and walls in concrete, machines for treating the digested materials and finally the power plant itself.

[16] In the last years newspaper headlines often expressed social opposition to biogas in the central plain: '*Biogas a Mignagola, l'impianto non si fa*' (Biogas in Mignagola, no to the plant), *La*

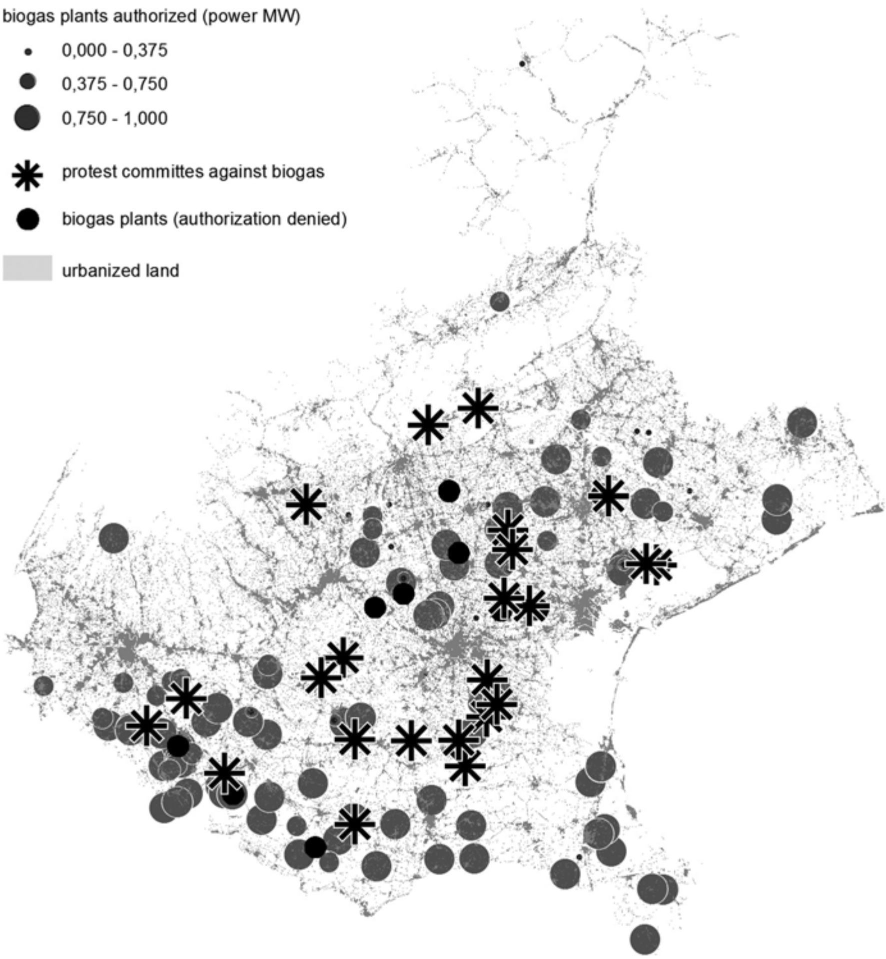

Fig. 6.2 Biogas plants authorised as of January 2013 in the Veneto region and local protest committees against them (our survey)

A brief discussion about some of the cases can help us understand the opposition to biogas better, the way it is expressed and the reasons behind it.

In the municipality of Limena (7,740 inhabitants), there are three agricultural biogas plants, one of which is less than 400 m from the edge of the town. The plant is on a cattle-breeding farm with 1,000 animals and 250 ha of agricultural land calculated for slurry spreading. The plant which produces 1 MWe was built in May 2009. Immediately after that, people started to complain about the smell and asked

Tribuna di Treviso, 02/02/2013; '*Un corteo di arrabbiati contro il biogas*' (An angry march against biogas), *La Nuova di Venezia*, 29/11/2011; and '*Quartiere Arcobaleno insorge: il biogas ci sta asfissiando*' (Arcobaleno neighbourhood protests 'biogas is choking us'), *Il Gazzettino*, 29/10/2009.

the municipality, one of the institutions that authorised the plant, to intervene. Newspaper articles about this case underlined the possible causes of the smell (some parts of the plant are uncovered) and the traffic generated by the plant (not all the raw materials for the plant come from the farm: they mainly buy effluent and biomasses on the market).

In the municipality of Santa Maria di Sala (situated between Padova and Venezia in the area known as the Graticolato Romano – 17,278 inhabitants), there is a village called Caselle in which a group of local residents organised a sit-in in 2010, collecting 1,000 signatures in a few days against a 1 MWe plant proposed for their territory. Citizen opposition convinced the municipality to reject the construction of the plant; the local medical authority issued an unfavourable opinion because of the risk of increased pollution and traffic, and the regional office of the Ministry of Cultural Heritage also refused to authorise the project, citing the need to protect the landscape in the Graticolato Romano.

The newspapers that reported the citizens' opinion highlighted among other things the visual impact of the plant (dimension, form), the heavy traffic due to the transport of raw materials and the extreme proximity to the inhabited area. Newspapers also reported that citizens of Caselle visited other biogas plants and 'everywhere they went, they found people complaining'. Finally, press articles emphasised the importance of social mobilisation in influencing the final political decision.

In the municipality of Piombino Dese (9,443 inhabitants), in the village of Torreselle, a group of people has been protesting since 2010 against the construction of a new biogas plant annexed to a cattle-breeding facility with 300 animals. The area is historically a centre for livestock farming: in the same municipality, they breed dairy cows, calves, beef cows, pigs and rabbits. The area is also very near to the River Sile Regional Park and in particular to its natural springs. The biogas plant is just opposite the village on the other side of the road. It was completed in 2012, despite the fact that the protest committee brought a legal action against the farm. The protestors lost the case in the Court of First Instance and are now waiting for the result of their appeal to a higher court.

The protest committees use the road to express their dissent, attaching very explicit protest banners to trees and fences[17] (Fig. 6.3). A brief examination of these banners can help summarise the arguments expressed against the biogas plants.

Banners in 2011: 'Via da cuà el biogas' (biogas out of here); 'A voi i profitti! A noi i liquami!!' (profit to you, slurry to us); 'Via il biogas dal centro' (biogas away from the town centre); 'Biogas la rovina del paese' (biogas the ruin of the village); '← m. 400 sorgenti del Sile, biogas m. 50 →' (springs of Sile river, 400 m; biogas, 50 m.); 'Biogas = inquinamento' (biogas = pollution); 'Spostate il biogas dalle case' (move the biogas away from the houses); 'Il biogas è la morte dell'agricoltura' (biogas is the death of agriculture); 'Contro il biogas a difesa dell'ambiente' (against the biogas, in favour of environmental protection). New banners in 2013: 'Biogas morte del territorio' (biogas, death of the territory); 'Bruciamo il mais e mangiamo energia

[17] In May 2011, the Google car photographed the streets of Torreselle village, which means that the 2011 banners can be seen on the Internet (Google Street View).

Fig. 6.3 The protest against biogas: personal, ethical and environmental reasons intertwine in the reaction against new agroenergy landscapes (*above*: 'Let's burn maize and eat electricity: logic!'; *below*: 'Biogas, death of the territory')

elettrica: logico!' (let's burn maize and eat electricity: logic!); 'Bruciare alimenti per il biogas non è il futuro dell'agricoltura italiana' (burning food in biogas plants is not the future of Italian agriculture).

As Selman noted (2010), behind every landscape conflict there is a narrative that feeds the discourses and the practices. In landscape conflicts about renewable energy, the rapid speed of change is often difficult to accept, and one-sided preservation ideologies emerge (Selman 2010). In this case, the narrative is better articulated. In addition to the classical hyperlocal 'selfish NIMBY'[18] attitude ('out of here'), the protestors also cite global ethical issues, such as competition between energy and food production or fairness in the distribution of benefits and disadvantages along the renewable energy production chain.[19] This level of the protest questions the very principle of biogas as a solution for producing energy.

Community and individual interests are intertwined: on the one hand, protestors often refer to the *village*, to the *community*, and to the collective disadvantage against the personal economic benefit accruing to the biogas owner, while at the same time – never explicitly put into words, but suggested in the interviews – fear of depreciation in real estate values is another important (and probably legitimate!) factor for mobilisation. It is also difficult to distinguish individual interest from collective interest when talking about public health questions in relation to smells and traffic.

Our research in newspaper articles and interviews shows that collective and individual dimensions coalesce in the disappointment people feel for being excluded from the decision-making process (as occurred in cases described in Zoellner et al. 2008, Rogers et al. 2008, and many others). This is obviously in conflict with 'procedural justice' (as stated by Leventhal in 1980, quoted in Zoellner et al. 2008).

But the problem is not only procedural, it is also substantial: 'agricultural' biogas plants are allowed to be built in agricultural areas, without any other spatial planning control. This has three consequences:

- As the decision as to the location of the plant is not subject to the planning process and therefore exempted from any possible participation, the decision-making process is opaque from the citizens' point of view, despite being absolutely legal ('we knew nothing about the project: they never said anything before starting building').
- The site location is proposed by the individual farmer – as with any private investment – and the public authority can only accept or reject the application. As noticed for other renewable energies elsewhere in Europe (Prados 2010), development of biogas is taking place without any integration into spatial and landscape planning, either at regional or local level.
- The only criterion the region now uses to regulate the 'agricultural' biogas plant is its power (<1 MW, with the great majority of plants producing the maximum permitted, i.e., up to 999 KW), with no other consideration, especially not for the local consequences of the size of the plant (e.g., increase in the transport of raw materials from outside the farm).

[18] This 'label' has been shown to be ambiguous and should be used carefully: 'selfish NIMBY' refers unambiguously to the negative aspects of the phenomenon (Van der Horst 2007).

[19] It is important to note that, in addition to regional financial support for the construction of the plant, in Italy the energy produced from renewable sources was supported until 2014 with a subsidy of € 0.28 for each kWh produced for a period of 15 years. Under these conditions, the cost of a biogas plant with an installed power of 1 MW which produces about 8,500,000 kWh per year could be amortised in only 4/6 years.

With a few simple words such as ‘biogas away from the houses’, people are expressing a spatial planning problem: compatibility between biogas plants (and perhaps a certain kind of industrialised agriculture) and residential areas. This problem is made even more acute by the existing dispersed settlement model in the area.

As we can see, the new biogas landscape has provoked widespread protest. Far from being just ‘one of the factors influencing the acceptance of renewable energy technologies’, landscape – ‘part of a territory as it is perceived by people’, as defined by the European Landscape Convention – is at the heart of the problem. Biogas landscape seems to be perceived not so much as ugly, but unjust (Olwig and Mitchell 2007). This can perhaps explain why aesthetic issues are rarely raised, and only in the case of outstanding landscapes (Graticolato Romano) and almost exclusively by public authorities. This also explains why people are completely unsatisfied with ‘mitigation’, consisting of planting trees to hide the view of the plant from the road (defined by local people as a ‘fig leaf strategy’), as happened at the Torreselle biogas plant.

The protestors’ perception of the biogas landscape must be investigated more deeply than we have done here. Nevertheless, it does seem to be strongly influenced by processes lying ‘beneath’ the landscape.

6.7 Final Remarks

Our observation of contested agroenergy-induced landscapes in the Veneto region has led us to a number of conclusions, both for our region and more in general for new post-carbon landscapes.

At the regional level, we can conclude that agroenergies have a significant effect on the landscape, although each agroenergy affects it in different ways and with different levels of acceptance. Policies on agroenergy consider neither the sum effect of various plants nor the interaction between them, nor the impact of each project locally. In the Veneto plain, the location of plants and their size are extremely important, because of our particular settlement model, where people live and farm side by side.

Local protest against agroenergy development seems to be situated on two levels: the first questions local transformation decisions; the second questions agroenergy in principle, and in particular biogas, in terms of fairness and democracy. The two levels are obviously interconnected.

This allows us to draw some general conclusions.

- Protests against agroenergy cannot be simply dismissed as NIMBY. On the contrary, they should be considered as a sign of problems and should be studied in greater depth in order to improve the efficiency of renewable energy development, both locally and in principle. In the case of biogas, the protest committees raise problems of fairness and democracy that must be taken seriously. The experience of laymen can often help to enhance the experts’ knowledge.

- As already highlighted (Prados 2010), Renewable energy development, and agroenergy in particular, must be considered and managed not as a separate sectoral policy, but as part of spatial and landscape planning.
- Dimension, location and timing of plants are not only important to understand the conflict (Van der Horst 2007) but also elements with which to design the new landscapes of carbon neutrality (Ghosn 2010).
- Landscape should not be considered something to be protected from agroenergy development; on the contrary, the new landscape of carbon neutrality should be designed within a framework of justice and democracy that is too often ignored.

Landscapes are public in the sense of being places shared by different individuals and communities, which matter to them in different ways. As such, they are open to particularly strong conflicts both as to what the future of the landscapes ought to be and as to who is entitled to have a legitimate say in the decisions to be taken about them (O'Neill and Walsh 2000).

If we want successful, nonconflicting development of renewables, procedural justice criteria (Zoellner et al. 2008) and the fairness of the change itself have to be taken into account.

In this sense, in order to learn to 'love the landscape of carbon neutrality', we do not only need to update the old underlying narrative with the new issues arising after the Kyoto Protocol (Selman 2010), but we also need to build a spatially fairer, more democratic renewable energy system. If this happened, the new landscape of carbon neutrality would be accepted more easily because it would *represent* a fairer and more democratic process.

Acknowledgements We wish to thank Andrea Turato, Amelia Laura Maris and Marta Rodriguez Moreno for assisting with this research.

References

Azar C (2003) Emerging scarcities: bioenergy–food competition in a carbon constrained world. In: Simpson D, Toman M, Ayres R (eds) Scarcity and growth in the new millennium. Resources for the future. Johns Hopkins University Press, Baltimore

Bastian O, Lütz M, Röder M, Syrbe R-U (2006) The assessment of landscape scenarios with regard to landscape functions. In: Meyer BC (ed) Sustainable land use in intensively used agricultural regions. Alterra Report No 1338. Landscape Europe, Wageningen, pp 15–22

Castiglioni B, Ferrario V (2008) Where does grandmother live? An experience through the landscape of Veneto's città diffusa. In: Berlan-Darqué M, Luginbhül Y, Terrasson D (eds) Landscape: from knowledge to action. Edition Quae, Versailles, pp 65–100

Devine-Wright P (2005) Local aspects of UK renewable energy development: exploring public beliefs and policy implications. Local Environ 10(1):57–69

Fabbri C, Soldano M, Piccinini S (2011) Il biogas accelera la corsa verso gli obiettivi 2020. L'Informatore Agrario 26:11–19

FAO – Food and Agriculture Organization (2008) Second FAO technical consultation on bioenergy and food security. Summary proceedings, Roma

Ferrario V (2007) Lo spazio agrario nel progetto di territorio. Trasformazioni dei paesaggi rurali nella pianura e nella montagna veneta. PhD thesis in Urbanism, Università Iuav di Venezia

Ferrario V (2010) Agropolitana: countryside and urban sprawl in the Veneto region (Italy). Rev Geogr/J Geogr 2–4:129–142

Ghosn R (2010) Energy as spatial project. In: Ghosn R (ed) Landscapes of energy, vol 2, New geographies. Harvard University Press, Cambridge, MA, pp 7–10

Kerckow B (2007) Competition between agricultural and renewable energy production. Q J Int Agric 46(4):333–347

Nadaï A (2007) Planning, siting and the local acceptance of wind power: some lessons from the French case. Energy Policy 35:2715–2726

Olwig KR, Mitchell D (2007) Justice, power and the political landscape: from American space to the European landscape convention. Introduction to a special issue. Landsc Res 32(5):525–531

O'Neill J, Walsh M (2000) Landscape conflicts: preferences identities and rights. Landsc Ecol 15(3):281–289

Prados M-J (2010) Renewable energy policy and landscape management in Andalusia, Spain: the facts. Energy Policy 38(11):6900–6909

Rathmann R, Szklo A, Schaeffer R (2010) Land use competition for production of food and liquid biofuels: an analysis of the arguments in the current debate. Renew Energy 35:14–22

Regione del Veneto (2009) Programma straordinario di intervento per l'attuazione della direttiva nitrati nel Veneto. Legge regionale 27 febbraio 2008, n.1, articolo 108 (Allegato A alla Dgr n. 398 del 24 febbraio 2009). Bollettino Ufficiale della Regione del Veneto 12

Reho M (ed) (2009) Agroenergia: attori, strategie e contesti locali. Franco Angeli, Milano

Riedel W (2013) Extreme landscape change by agricultural failures: the case of the northern Schleswig-Holstein. Naturschutz Landschaftsplanung 45(1):29–32

Rogers JC, Simmons EA, Convery I, Weatherall A (2008) Public perceptions of opportunities for community-based renewable energy projects. Energy Policy 36:4217–4226

Selman P (2010) Learning to love the landscapes of carbon-neutrality. Landsc Res 35(2):157–171

Upreti BR (2004) Conflict over biomass energy development in the United Kingdom: some observations and lessons from England and Wales. Energy Policy 32:785–800

van der Horst D (2007) Nimby or not? Exploring the relevance of location and the politics of voiced opinions in renewable energy siting controversies. Energy Policy 35:2705–2714

Varotto M (2012) Geografie del declino civico? Il fenomeno dei comitati spontanei nel Veneto. Boll Soc Geol Ital 13(5):43–58

Veneto Agricoltura (2010a) Colza: confronto varietale, research report. http://www.venetoagricoltura.org/upload/pubblicazioni/Scheda_Colza_xWeb.pdf. Accessed 10 Mar 2013

Veneto Agricoltura (2010b) Rapporto sulle Bioenergie in Veneto 2010, research report. http://www.venetoagricoltura.org/basic.php?ID=3250. Accessed 10 Mar 2013

Wolsink M (2007a) Wind power implementation: the nature of public attitudes: equity and fairness instead of backyard motives. Renew Sustain Energy Rev 11(6):188–1207

Wolsink M (2007b) Planning of renewable schemes: deliberative and fair decision-making on landscape issues instead of reproachful accusations of non-cooperation. Energy Policy 35(5):2692–2704

Wüstenhagen R, Wolsink M, Bürer MJ (2007) Social acceptance of renewable energy innovation. An introduction to the concept. Energy Policy 35(5):2683–2691

Zoellner J, Schweizer-Ries P, Wemheuer C (2008) Public acceptance of renewable energies: results from case studies in Germany. Energy Policy 36:4136–4141

Zoppelletto M (2008) Monitoraggio impianti biogas in regione Veneto, research report. http://www.venetoagricoltura.org/upload/Mappatura_monitoraggio_impianti.pdf. Accessed 10 Mar 2013

Part III
Hydropower and Mountain Landscapes

Chapter 7
The Evolution of Renewable Landscapes in Sierra Nevada (Southern Spain)

From Small Hydro- to a Wind-Power Landscape

Marina Frolova, Yolanda Jiménez-Olivencia, Miguel-Ángel Sánchez-del Árbol, Alfredo Requena-Galipienso, and Belén Pérez-Pérez

Abstract We explore the processes through which small hydropower and later on wind-power landscapes emerged in the Sierra Nevada mountain range in Andalusia (southern Spain) and the evolution of landscape practices and landscape values related with these energies. Throughout the history of small hydro development in our study area, the attitudes to it have varied between rejection and acceptance. At the same time, the landscape features inherent to them were sometimes perceived as negative impacts and sometimes assimilated positively as new landscape values, depending on the historical and social context. The analysis of the evolution of hydropower in mountain landscapes and the related practices provides useful lessons for understanding the influence of new forms of renewable energy, not only in terms of their landscape impact but also in terms of the role of landscape values in determining their acceptance or rejection by different stakeholders.

Keywords Hydropower landscape • Wind-power landscape • History • Tourism • Sierra Nevada (Spain)

M. Frolova (✉)
Dpto. Análisis Geográfico Regional y Geografía Física, Facultad de Filosofía y Letras, Universidad de Granada, Campus de Cartuja s/n. 18071, Granada, Spain
e-mail: mfrolova@ugr.es

Y. Jiménez-Olivencia • M.-Á. Sánchez-del Árbol • A. Requena-Galipienso • B. Pérez-Pérez
Facultad de Filosofía y Letras, Universidad de Granada,
Campus de Cartuja s/n. 18071, Granada, Spain
e-mail: yjimenez@ugr.es; msdarbol@ugr.es; arequena@ugr.es; belenperez@ugr.es

M. Frolova et al. (eds.), *Renewable Energies and European Landscapes*,
DOI 10.1007/978-94-017-9843-3_7

7.1 Introduction

Mediterranean mountain landscapes can be defined as a collage of clearly distinguishable features and processes, both natural and cultural, as spaces containing a wide variety of resources and as a concept of great symbolic importance. In fact, the Mediterranean mountain systems have always been highly valued as spaces for the establishment and production of tangible and intangible assets, which have bequeathed us countless heritage values, as well as offering shelter (within a more or less confined space) to autochthonous flora and fauna. All of this has to some extent been preserved by the relative isolation of the high and mid-mountain regions and because, since the end of the nineteenth century, they were assigned various environmental, forestry and recreational functions. This led to many Mediterranean mountain landscapes being declared protected areas.

At the same time, these regions were an important resource for different uses linked with soil, water, energy and a multitude of varied tourism activities, many of which have been on offer for generations. In recent decades, the Mediterranean mountain landscape, historically shaped by agriculture and an extensive grazing system, has suffered the abandonment of terrace cultivations, the gradual tertiarisation of its economies, the continued afforestation of agricultural land, the decline in the rural population, the effects of the Common Agricultural Policy, the gradual environmentalisation of rural policy (López-i-Gelats et al. 2011; Tzanopoulos et al. 2011) and the development of renewable energy infrastructures. Mountain landscapes, traditionally indisposed to abrupt change, as a result of their fragile ecosystems, low population density, local idiosyncrasies, remoteness and inaccessibility and lack of infrastructures, have been affected by a rapid process of change and appear to many as symbolically industrialised (Szerszynski 2005) by afforestation on an industrial scale, renewable development, etc. The uncertain future of mountain agriculture and the shift in the geographical imagination of rurality towards consumption and leisure (Hadjimichalis 2003) have also created a new context for rural and economic development in the Mediterranean mountains (Tsanopoulos et al. 2011). There has also been a significant process of industrialisation of mountain landscapes in recent decades through the development of small hydropower plants and wind and solar farms, which has raised issues regarding landscape practices and different tensions and conflicts. A striking example of this industrialisation are wind turbines and their related artefacts, which have been the most direct and visible consequence of renewable power development in the Spanish mountains over the last 10 years. Interestingly, this industrialisation is neither new nor more impacting on mountain landscape than earlier industrial developments given that by the end of the first half of the twentieth century, a large number of European mountains had already become hydroelectricity-producing areas.

What is the landscape significance of renewable energy developments in the Mediterranean mountain areas? Is their impact on the landscape an important factor in their acceptance or rejection by the local population? What is the relation between energy production and other mountain landscape practices, like tourism, water management, agriculture, nature protection, etc.?

Although the social tensions surrounding the development of hydropower have been analysed in previous social and geographical studies of the acceptability of renewable energy (McCully 1996; Abbasi and Abbasi 2011; Diduck et al. 2013; Hang Bui et al. 2013), the question of the changing landscape values caused by hydropower development has been a marginal aspect of both landscape study (Frolova 2010) and the analysis of hydropower development. In most cases, the relation between hydropower and landscape was treated in terms of 'impact', without considering any other dimensions of this relation.

This chapter explores the processes through which hydropower and then windpower landscapes have emerged in the Sierra Nevada mountain range in Andalusia (Southern Spain) and the evolution of landscape practices and landscape values related with these energies. We focus on small hydropower development, based on a model of electricity production known as 'small-scale electrification' (Núñez 1998:268), which has been the dominant form of hydropower in the Sierra Nevada due to several limiting factors. Firstly, the local rivers have a relatively low flow rate due to annual summer droughts. Secondly, the huge inherent technical problems made the construction of large dams economically unviable, and thirdly, the demand for electricity in an area of small towns and villages with little or no industry was relatively low, rendering large installations unnecessary.

Our pilot study is based on our analysis of both previous research and direct documentary information on hydropower, wind and solar power in Sierra Nevada, policy documents, fieldwork and in-depth qualitative interviews with the different stakeholders involved in the development of renewable energy projects.

7.2 The Changing Image of Hydropower and Its Impacts

Until the 1970s, hydropower was considered to be one of the cleanest, most versatile sources of energy. Water as a fuel for hydropower energy is a renewable source which remains practically intact and reusable. Electricity generation based on hydropower has much lower CO_2 emissions than oil or coal-fired power plants. In addition, the decommissioning of hydropower plants is relatively simple and no hazardous waste is generated. Many hydropower schemes are used not only for power generation but also for flood management, irrigation or drinking water supply (Bratrich et al. 2004). In addition, the visual impact of hydropower infrastructures tends to be lower than that of other energy infrastructures, and reservoirs can also be used for recreation and fishing. All these perceived virtues of hydropower led the governments of different countries to develop large hydropower projects until the 1970s, when the very positive attitude towards hydropower projects began to be questioned (Abbasi and Abbasi 2011).

In the mid-1970s, many reports appeared on the adverse impacts of implementing hydropower projects intensively and repeatedly across large areas, and experts began to realise that these energy infrastructures could have serious negative ecological and social impacts. In general terms, the impacts of hydropower plants on fluvial landscapes are difficult to measure, because different geographical scales are involved and diverse landscape elements are affected (Frolova 2010). Hydropower dams modify flow regimes, act as barriers to fish migration, trap nutrients or sediments, dry up floodplains and divide habitats (for a review, see Bratrich et al. (2004) and Abbasi and Abbasi (2011)). Dramatic changes occur in the downstream ecosystems, reservoir catchments, artificially created lakes and sometimes in the landscapes of entire river basins. The most common landscape impacts of dams include the inundation of areas traditionally used for agriculture, the massive displacement of people and the loss of valuable cultural landscape features. Hydropower therefore affects much larger tracts of land than most other types of energy and causes much more profound changes to the landscape than other renewables.

In Spain, a country with one of the largest numbers of hydropower plants in the world, warnings as to the negative impact of hydropower projects had appeared by 1980 (Frolova 2010). The European Commission White Paper on Renewable Energy of 1997 was implemented in Spain the following year (Royal Decree 2818/1998), and as a result, only hydropower based on small and mini plants is perceived as 'clean energy' (Royal Decree 2818/1998) because it is considered to have a relatively modest, localised impact on the environment. Even so, small-scale hydropower systems (SHS) also have adverse effects on fish population and may have negative impacts on the landscape (as suitable sites for small hydro schemes may be in environmentally sensitive areas perceived as pristine and natural), on recreational activities, etc. In addition, if the environmental problems caused by small hydro are analysed on the scale of impact per kilowatt of power generated, it becomes evident that the problems that would be caused due to widespread use of SHS would be no less numerous and no less serious than those caused by large hydropower projects (Abbasi and Abbasi 2011). That is why in Galicia, one of the autonomous regions with the most extensive development of small hydro in Spain, a special River Law passed in 2006 put many of these projects on hold, presenting negative landscape and ecological impact as an important argument against the construction or the restoration of small hydropower plants (Frolova 2010).

Concerns for river landscapes have found a place in both water and energy policies in Spain as a result of developments at the European level. For instance, the application of the 2000 European Landscape Convention (ELC) encouraged several autonomous regions to incorporate landscape as an important issue in land use regulation (Frolova 2010; Frolova and Pérez Pérez 2011). In the same way, the Water Framework Directive (WFD) adopted in 2000 by the European Parliament set up a framework for action in the field of water policy.

Pedro Arrojo, one of the founders of the Foundation for a New Culture of Water (1998) (see www.unizar.es/fnca) defined landscape as 'an essential component of people's surroundings, an expression of the diversity of their shared cultural and natural heritage, and a foundation of their identity' and considered its recognition in the ELC (Chapter II, Art. 5) as an important institutional base for the new paradigm of water management (Arrojo Agudo 2004: 30):

> The idea that landscape is an essential part of individual and social wellbeing; the reference to the natural and historic causality of landscape urges us to reject treatments that seek only to paper over the cracks, acknowledging the factors that have made certain forms of the territory possible, and the application of the provisions on landscape protection, management and planning of the ELC to water landscapes, one of the most vulnerable and endangered areas given the aspirations of the people affected, all confirm the ideas that we defend.

We cannot however limit the analysis of the relationship between hydropower infrastructures and mountain landscape only to their negative impacts. The analysis of the relationship between landscape and renewable power should take into account the implications and superposition of different types of practices and attitudes towards energy, environment, tourism and land use (Frolova 2010).

Attitudes to renewable energy infrastructures in Spain have often been ambiguous and have fluctuated between acceptance and rejection throughout the twentieth and twenty-first centuries. In some cases, these infrastructures were perceived only as negative impacts on the landscape, and in others, new landscape values and practices have emerged in relation to them. This occurred, for instance, when energy installations such as dams, reservoirs, old hydropower plants, etc., became part of the industrial heritage and rather than harming tourism became tourist attractions in themselves. In some cases, energy production developed out of a need to supply electricity to power the infrastructures required for the development of tourism in mountain areas (although renewable energies were not always the main source). While some of the hydropower infrastructures became an important part of the local landscape and of established tourism practices, it is still not clear what new values if any have emerged from wind-power landscapes.

Our analysis of the evolution of the relationship between hydropower and mountain landscapes and the practices related with them could provide useful lessons for understanding the influence of new forms of renewable energy, not only in terms of their landscape impact but also in terms of understanding landscape values and practices.

We begin by presenting our case study. We then go on to reconstruct the process of development of renewable energies in Sierra Nevada and its links with the mountain landscape, paying particular attention to the evolution of small hydropower and its relationship with tourism. Finally, we analyse hydro- and wind-power infrastructures as elements of Sierra Nevada landscapes.

7.3 Case Study

Our study area encompassed nine municipalities to the east and south-east of Granada in the foothills of western and southern Sierra Nevada (Fig. 7.1). Seven of these municipalities have their own small hydropower plants, three have photovoltaic solar farms and one has a wind farm. Small hydro forms quite an important part of the landscapes of the study area (Fig. 7.2). Hydropower was developed most

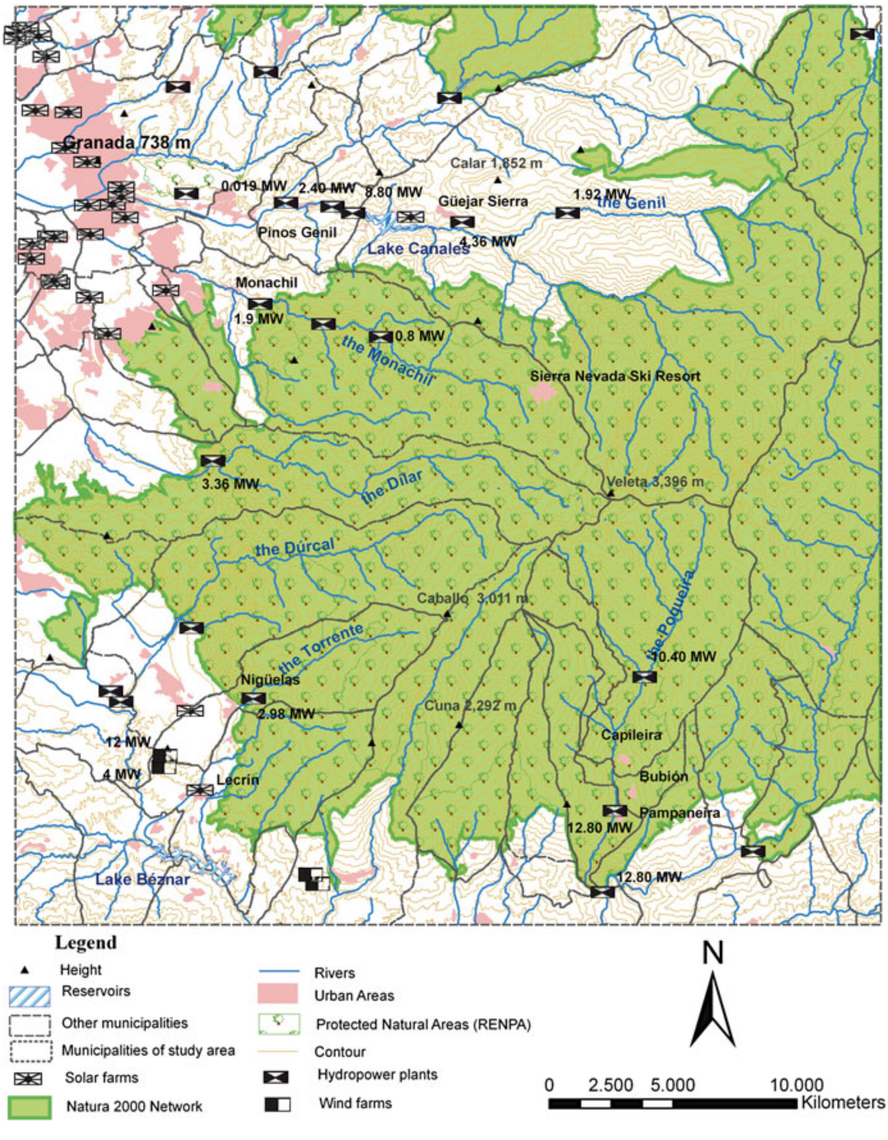

Fig. 7.1 Map of study area with hydropower plants, wind and solar farms and protected natural areas (RENPA and Network Natura 2000)

intensely in the river Monachil and the Lecrín Valley, and in the Poqueira valley, where the infrastructures (water tanks, headraces, buildings, etc.) have adapted to the topography, and in the valleys of the rivers Genil and Maitena, where the only large reservoir (Canales) is located.

Ever since the Nasrid period (thirteenth to fifteenth century), each valley formed its own administrative unit, a fact that was highly beneficial when it came to sharing

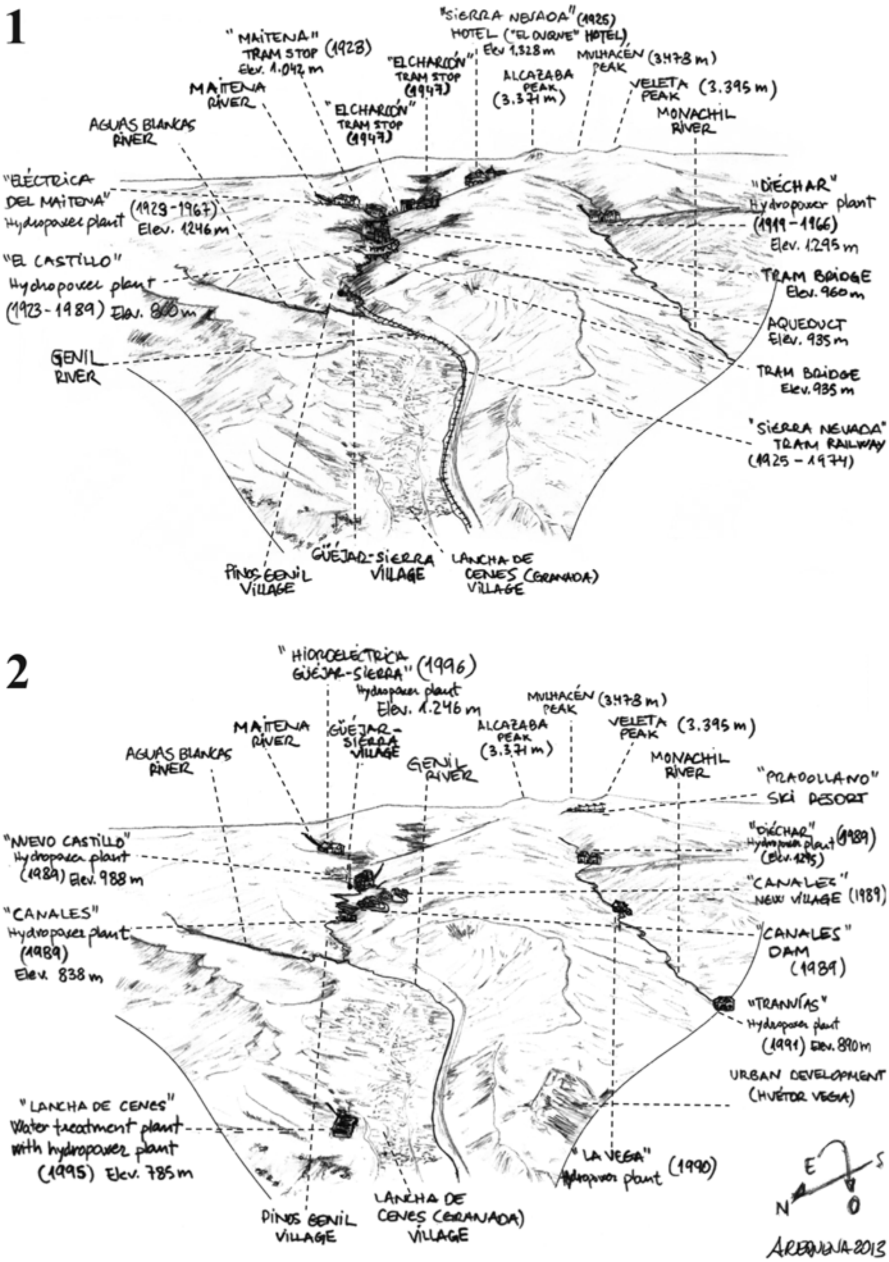

Fig. 7.2 Hydropower landscape of Genil valley in 1910–1925 (*1*) and 1925–1996 (*2*). Drawings of A. Requena Galipienso

out the water as the valleys were also the units for water management (Trillo San José 2004). In order to control the local hydrological cycle and so guarantee sufficient flow levels in the spring and summer, a complex system of water channels (*acequias*), transfers and artificial refilling was required. Even today, the different elements of traditional hydraulic engineering, the drystone terraces and a strict organisation of the use of water are considered the best means of maintaining the fragile equilibriums of these mountain valleys and their valuable, eco-cultural landscapes. Irrigation, the division of land ownership into smallholdings and the diversification of production into a wide range of crops are but three common practices inherited from the ancient organisation of agricultural land bequeathed by the Nasrids (Jiménez Olivencia 1991). This is a case of one of the best-known cultural landscapes of Sierra Nevada, that of the Alpujarra which forms part of our study area. Water management benefited from the natural regulation produced by snowfalls and also by the infiltration of streams created by melted snow, which feed natural springs and other water sources lower down (Castillo Martín 2010). The important landscape values of Sierra Nevada have led to the emergence of conservationist policies and to the granting of protected heritage status to many of the landscapes in the study area, via various different declarations protecting natural[1] and cultural[2] heritage.

The part of study area is also strongly influenced by its proximity to the city of Granada, the capital of the province, and some of the towns and villages we studied fall within its metropolitan area and are affected by the dynamics of the city, but other one, as the villages in the Poqueira valley (Capileira, Bubión and Pampaneira) and Güejar Sierra, are sufficiently distant from the provincial capital to operate under their own dynamic of low energy consumption more typical of high mountain villages.

In spite of the fact that in our area, the demand for energy is in general relatively limited with the exception of Monachil[3] and that various other uses of water (domestic supply, crop irrigation, agriculture and tourism requirements) take priority over its use in energy production, there has been considerable development of renewable energy systems and in particular of small hydro. Since the application of

[1] Most of our study area forms part of the Sierra Nevada natural space, which itself belongs to the Red Natura 2000–Nature Network 2000 (ZEC Special Conservation Area and ZEPA Special Protection Areas for Birds). Sierra Nevada was declared 'Biosphere Reserve' by UNESCO, 'National Park' by the Spanish Government and 'Natural Park' by the Regional Government of Andalusia. There are also a number of smaller sites protected under different status concepts such as the Nigüelas Fault Natural Monument, the Ramsar Site in Padúl and the glacial lakes near the mountain peaks (both part of the IHA Inventory of Wetlands of Andalusia).

[2] The 'Alpujarra Media y Tahá' was declared a historical site by the Regional Government of Andalusia.

[3] Its boundaries encompass Pradollano, the Sierra Nevada ski resort, which has around one million visitors each winter (Cetursa, http://cetursa.es/ 2012). As a result, this village has a much higher demand for energy than the others we studied. In 2010, for example, the demand for electricity per capita in Monachil was 8.08 MW compared to 2–4 MW per capita in the other villages in the study area (based on the data of *Sistema de Información Multiterritorial de Andalucía* 2010, http://www.juntadeandalucia.es/institutodeestadisticaycartografia/sima/).

Table 7.1 Renewable energy systems in the study area

Municipality	Solar PV power installed capacity	Wind farm/ installed capacity	Hydropower plant/installed capacity
Güejar Sierra	79.8 KW		Maitena/1.92 MW Nuevo Castillo/4.36 MW Rosario/0 MW
Pinos Genil			Canales/8.8 MW La Vega/2.4 MW Eléctrica de Blanqueo/0.019 MW
Monachil			Diéchar/0.8 MW Tranvías/1.9 MW
Dílar			Dílar/3.36 MW
Nigüelas	20 KW		Nigüelas/2.98 MW
Lecrín	15.9 KW	Lomas de Manteca/4 MW Lecrín/12 MW	
Capileira			Poqueira/10.4 MW
Bubión			Duque/12.8 MW
Pampaneira			Pampaneira/12.8 MW
Total	**115.7 KW**	**16 MW**	**62.54 MW**

Sources: Agencia Andaluza de Energía 2012, in-depth interviews

the Water Act of Andalusia, approved by the Regional Government in 2010, which established minimum water levels or 'ecological flow' in Andalusian rivers, the already fierce competition for water in the study area has intensified. This is due to the fact that most of the crops require irrigation and that the Sierra Nevada ski resort puts considerable pressure on the water levels in the rivers Monachil and Dílar by storing large quantities of water for producing artificial snow. This makes it difficult to maintain the ecological flow levels and ecosystems of these two rivers, both of which belong to the Sierra Nevada natural space, and goes against the grain of the conservationist policy applied in this area since the 1980s.

All of these factors make it enormously difficult to increase the hydropower capacity and in some cases have caused it to fall with the only real potential lying in restoring or renovating existing plants (normally very old) and putting those dams currently not used for electricity production into service. In this context and within the framework provided by the European Union for the implementation of alternative energies in different European regions, wind and solar farms had been installed in our study area since the beginning of the twenty-first century.

Wind farms installed in some of the municipalities of our study area since 2004 (see Table 7.1) have had a considerable impact on the landscape of the mid and low mountains, so raising new issues regarding landscape practices and values. While the installation of wind power is difficult in the Alpujarra due to the Sierra Nevada National Park protection measures, two wind farms have been developed in the neighbouring Lecrín Valley since 2004 (inside the study area) with an installed capacity of 16 MW.

7.4 The Development of Renewable Energy in Sierra Nevada and Emerging Landscapes: From Small Hydropower to New Renewable Sources

In Sierra Nevada, the emergence of the small hydropower mountain landscape was a gradual process which started at the end of the nineteenth century with the construction of the first energy infrastructures necessary for the industrial development of the province of Granada. Some of the owners of waterfalls and watermills converted their existing infrastructures into hydropower plants that were known as 'factories of light' or combined the two uses (Núñez 1994). This resulted in a proliferation of small hydropower plants that supplied on the one hand all the street lighting for the small, neighbouring villages and indeed for the city of Granada and also for the small-scale industrial activities that were often housed within the plant itself.

The origin and development of hydropower in Sierra Nevada took place within the context of the emergence in Spain, in the late nineteenth century, of a current of thought, known as regenerationism, which manifested itself in terms of water policy under the general guidelines of the '*paradigma hidráulico*' or 'water management paradigm' (Naredo 1997; Frolova 2010). The ultimate objective of this state-based water regulation system, which dominated Spanish water policy in the twentieth century, was to ensure the availability of cheap water to permit economic growth (Saurí and del Moral 2001). This form of water management was provided by a system made up of large, modern infrastructures based on water reservoirs, dams for generating hydroelectricity and networks of irrigation channels. The *paradigma hidráulico* embodied an instrumental attitude to water and had a direct effect on the perception of hydropower landscapes (Frolova 2010). This paradigm was closely related to the prevailing perception in Spain of the river as a hostile, uncertain and threatening force, an idea which arose as a consequence of the uneven distribution of water resources and their relative shortage in Spain (del Moral 2000). Mediterranean rivers have a specific hydrology regime, characterised by extremely low flows during long dry seasons and severe torrential floods. Therefore, 'tamed' or trapped water has a very positive image, as a base for the development of 'green' landscapes, irrigated fields, orchards and picturesque artificial 'lakes' formed by water reservoirs (Frolova 2010).

The hydropower plants and installations left their mark on the mid-mountain areas of Sierra Nevada producing relatively small, albeit significant, energy landscapes. Despite being small in size, these electricity production plants abound throughout the Sierra and are particularly frequent in the western valleys, almost all of which have been developed to some degree.

Attitudes to these infrastructures have varied over the years. Until the late 1980s, hydropower landscapes in Sierra Nevada were viewed positively as in other Spanish mountain ranges. After various parts of Sierra Nevada were declared protected areas, some hydropower infrastructures came to be viewed as negative features in the landscape; others meanwhile have become an important part of the industrial heritage and of the local landscape and even have been used for tourism purposes.

7.4.1 Evolution of Hydropower Landscape and Its Tourism Value

The relationship between the hydropower mountain landscapes and tourism is manifested in various forms in Sierra Nevada. These include the link between the exploitation of energy resources and tourism development in some valleys and the 'new' heritage and tourist value of the material remains of the hydroelectric plants built since the end of the nineteenth century.

Hydropower was developed most intensely in the river Monachil and the Lecrín valley, and in the Poqueira valley, where the infrastructures (water tanks, headraces, buildings, etc.) have adapted to the topography, and in the valleys of the rivers Genil and Maitena, where the only large reservoir (Canales) is located.

We can distinguish three periods in evolution of the hydropower/tourism relationship: the first which ran from the end of the nineteenth century to the 1930s; the second, from the 1940s to the 1970s; and the third, from the 1980s onwards. During the first stage, there was a close link between investment in electrically powered transport for tourist development and hydropower deployment. An archetype of this tourist landscape based on energy production is that of the Genil river valley. Some new hydropower plants were built over the river Maitena (a subsidiary of the river Genil) in the 1920s to provide power for the ambitious Sierra Nevada Tram Railway (*Tranvía de Sierra Nevada*) project (1925–1974). This project was based on similar systems in the Alps, which sought to improve access to the most interesting mountain landscapes for tourists and sports enthusiasts (skiers, mountaineers, hikers).

The Genil valley played a historical role as a base for the tourist 'conquest' of Sierra Nevada. For many years, it was the only option for travellers and tourists wishing to visit the high mountain areas, and it was also the most visited valley. The tram railway was part of an ambitious tourism project that sought to transport visitors from Granada to the Hotel del Duque (situated at the top of the Genil valley at an altitude of 1,500 m), from which they would be able to ride on horseback to a cable car that took them up to the summit of Veleta (the range's second highest peak at 3,396 m). This project clearly depended on the development of hydropower in this area. In the end, however, the planned cable car was never constructed due to technical difficulties and the train was not profitable, due to the insufficient demand from tourists wishing to visit the high mountain areas, although it remained in operation for several decades.[4]

The decline of tourism in the Genil valley, between the 1940s and 1970s, coincided with the rise in hydropower and tourism in the other valley in our study area, the Poqueira (*Barranco de Poqueira*). A number of installations had already appeared in this valley, during the first stage of hydropower development but the most important were constructed between 1956 and 1981: 'Poqueira', 'Pampaneira' and 'Duque', which have created their own genuine hydropower landscapes (Fig. 7.3).

[4]The tram link closed in early 1974, not only because it was losing money but also because construction of the Canales reservoir was about to begin, and 5 km of the track were due to be flooded.

Fig. 7.3 Infrastructures of the hydroelectric plant in Pampaneira situated on the edge of the Poqueira valley historic site (M. Frolova 2013)

During the 1970s the relationship between the energy system and the territorial system changed. Following the death of Franco, Spain opened up to the rest of the world and mass tourism took off in Andalusia, especially in the coastal area. Water resources were now required in large quantities for new needs. The population of Sierra Nevada fell sharply, leading to the abandonment of a wide array of traditional uses and the deterioration of productive systems, internal communications and water control and distribution systems. However, the dramatic socioeconomic transformations brought about by the new territoriality imposed by urban systems on the mountains, as a result of recolonisation and tertiarisation processes produced by pressure from the tourism and construction sectors (Montiel Molina 2003) themselves favoured to a large extent by improvements in access to the Poqueira valley, have enabled this area to overcome its long-standing problems of poor communications and relative isolation.

One of the most evident of these changes has been the explosion of tourism-related activities, which have led to new models of territorial development of local mountain society, based on the socioeconomic reactivation of the Poqueira valley and the conquest of the high mountain landscape by the tourism industry. Tourism has become an important source of revenue for the economy of the study area, with a range of attractive activities and in particular downhill skiing. The expansion of tourism on the Spanish *costas* also required improved and increased water supply, and many mountain rivers in the Mediterranean basin became important water sources for coastal tourism and urban development. One example was the Guadalfeo river with its large dams and reservoirs, which from the 1980s onwards were constructed (the Rules dam) or reconstructed (the Beznar dam) close to our study area.

Hydropower also played a part in the territorial evolution of the region. In the neighbouring Genil valley, this new wave of hydropower and large-scale use of water resources was manifested in the construction of the Canales reservoir in the municipal area of Güéjar Sierra (1975–1988). At the foot of the dam, there is a hydroelectric plant, the only one of its kind in our study area, in which the other rivers are free-flowing. The reservoir soon became one of the most important tourist attractions in the Genil valley, as did the Beznar reservoir in the Lecrín valley.

Concurrently, a period of 'heritagisation' began in the mid and high mountains. In 1982, three villages in the Poqueira valley were declared as a *Conjunto Histórico-Artístico* (Group or Area of Historic/Artistic Importance) at a regional level, while Sierra Nevada was declared a Biosphere Reserve (1986), a Natural Park (1989) and finally a National Park (1999). And recently, there have been calls for an application to be made for the Alpujarra villages to be included on the list of UNESCO World Heritage Sites. The Alpujarras have made the most of their traditional forms of settlement and the tourist resources of the mountainside. This emblematic tourist landscape has been coexisting without any problems or conflicts with hydropower infrastructures sited nearby prior to its 'heritagisation', in spite of their significant landscape impact (Fig. 7.3).

Once part of the study area was declared a protected space, the process of installation of hydropower plants came to an almost complete standstill, as industrial uses of the Sierra's resources were considered incompatible with its conservation. Many projects have been rejected for breaching the regulations protecting the Sierra Nevada National Park, although there have been some exceptions such as the council-owned hydroelectric plant set up in the hydroelectric station in Lancha de Cenes, built in 1995 as part of a larger drinking water treatment plant, and as another plant in Nigüelas, built in 1996 on the river Torrent.

Various tensions and conflicts arose at the same time in relation to projects for setting up mini-hydroelectric plants. The Guadalquivir River Management Board, for example, rejected an application to build a small plant on the river Dílar on the basis of the objections put forwards in a concerted campaign by various green organisations and anglers' associations. Ecologists also protested on various occasions about the damage caused during the construction in 2012 of a hydroelectric plant in Nigüelas, a village with about 1,200 inhabitants, although this plant has popular local support (as does the Tranvías plant in the Monachil river) because it is run by the council and the profits remain in the village. During in-depth interviews, different local stakeholders told us that for him or her 'hydropower' was 'synonym' of Nigüelas, because the plant 'provided jobs for almost half of the village population' and income to fund its economic development.

7.4.2 Emerging Energy Landscapes

The decline in hydropower production in the study area has been offset to some extent since the beginning of the twenty-first century by the development of new renewable energy systems such as wind power. This shift in the form of energy production caused changes in some landscapes and new conflicts and tensions, although some of them were similar to those caused previously by hydropower.

During our interviews with local stakeholders, we discovered that most of them considered wind-power generation as a reasonable, valued alternative for the economic development of the area and that they did not see their landscape impact as negative.

In general, we found no evidence of an organised opposition to the wind farms installed so far in this area, although some local tensions exist and there are certain doubts amongst local dwellers as to how long the traditional landscape qualities that rural tourists come to the area to enjoy will last.

A range of factors determine the acceptance of wind-power projects by the local population. First of all, windmills provide substantial income for some rural landowners and town councils. Secondly, they are compatible with traditional rural activities such as agriculture and livestock grazing and with most other local business activities.

Interestingly, most of the local stakeholders we interviewed accepted windmills, and anti-wind-power initiatives come mainly from external social actors like nature protection organisations, landscape management experts and urban dwellers who enjoy escaping to the countryside and in some cases from people that run rural tourism businesses. So far, the only anti-wind-power initiative was launched at the beginning of 2000s by a British company that wanted to build a rural hotel complex in the Lecrín valley. Although they failed to prevent wind-power deployment in this area, thanks to their initiative a detailed study on landscape impact was carried out and its conclusions helped to reduce the number of wind-power projects for which permission was granted.

Sometimes, opposition to wind power arises out of the differences between the territorial development models chosen by neighbouring municipalities. For example, Nigüelas Town Council complained that the landscape of their municipality had been spoilt by the wind farm installed in a neighbouring village, and that this village had received all the economic benefits brought by projects of this kind, while their village was left with all the disadvantages. In fact, landscape values are often connected with the economic benefits of renewable projects for local residents. Our interviews revealed a strong connection between the public acceptance of landscape changes brought by renewable development and the economic gains this development brings. Thus, the local residents are more prepared to accept landscape changes if they participate in renewable power development in terms of the economic benefits to be reaped from it.

Today, these new landscapes are evolving within a new economic context of crisis and uncertainty in Spain as regards energy regulation and the feed-in-tariff system, as a result of which the forecasts for the development of renewables and their influence on the local landscape have been drastically reduced in the last 3 or 4 years.

7.5 Renewables: A Blot on the Landscape or a Specific Landscape Feature?

What do renewables mean in the landscapes of our study area? Is their landscape impact negative? Can they be considered as specific elements of the Sierra Nevada that have been adapting simultaneously to other features of mountain landscapes and in some cases have acquired significant historical value? The transformations in the mountain landscape wrought by the appearance and development of renewables have affected landscape forms and values but have not contributed much to a reformulation of landscape and nature protection practices in Sierra Nevada. Most hydropower infrastructures were built before the various declarations protecting natural and cultural landscapes in the area. Some of these hydroelectric plants continued to operate after these declarations, and in the 2000s, new renewable infrastructures were built close to the protected areas and are not perceived negatively by many local stakeholders.

In addition, most of the hydropower plants in the study area are small due to the region's particular geographical characteristics and this reduced their landscape impact. Most of the old 'factories of light' in the study area were built of masonry and had tiled roofs and in general maintained a level of design and execution that mitigated their visual impact on the landscape, despite being located in landscapes of exceptional beauty. In addition, they are normally located in secluded areas of the valleys and are visually fairly discreet, with certain exceptions, such as the Pampaneira or El Duque plants.

The other infrastructures associated with hydro power plants in general blend in well with the landscape, except perhaps for the discharge pipes that cover the waterfall. Some of these, such as those at the Poqueira plant, are completely uncovered and are very clear to see as they run down hills with sharp inclines.

The importance for tourism and in terms of landscape of some hydropower landscape features should also be noted. These include, for example, the Canales reservoir with its picturesque walk for tourists, a true landscape milestone in the Genil valley and a large number of pipelines of considerable length and made with different construction techniques (excavated in the rock, built from natural stone, concrete, metal pipes, etc.) that supplied and indeed continue to supply the hydroelectric plants situated in the different valleys of the Sierra.

Another feature of the hydropower system is the water diversion channels that take water from the river to the plants. These channels normally start from small semi-dams next to the river and appear to be either excavated out of the rock or hanging from it. Their visual impact is quite low, as they follow the natural contours, and in their open-air stages, they look very similar to irrigation channels. Large sections pass through tunnels bored through the rock or underground, and dotted along their path are a whole series of associated features such as the caretaker's house, loading chambers and pumping chambers, all built in a similar style to that of the plants themselves. Some of these channels, such as the Espartera on the river Dílar, have become very popular routes for hikers along which the different elements associated with the hydroelectric plant have become important milestones.

As a result, some of the hydropower installations in the study area today form part of the cultural heritage and have acquired a certain symbolic value, to the extent that they need to be managed as an integral part of any landscape restoration programme. Some of the oldest power plants have been restored and are now in service again, while others lie derelict in a severe state of ruin.

The landscape impacts of wind power in Sierra Nevada were quite different from those of hydropower. Although the environmental impacts of wind-power infrastructures are far less dramatic than those produced by other power infrastructures and are mostly limited to the perceived impact on the landscape (Pasqualetti et al. 2002; Burrall 2004), land use conflicts and problems with noise pollution and hazards to birds (Wolsink 2000), their visual impact is very strong. However, as our in-depth interviews with different stakeholders demonstrated, this impact does not always result in a negative perception of these infrastructures and sometimes is totally ignored.

Could these emerging energy landscapes become an important part of the local scenery, a future 'historical' landscape accepted by the most of the population as were most of the hydropower plants in the last century? The role of landscape values in determining the acceptance or rejection of wind farms by different stakeholders is not always clear-cut. Negative views are often the result of territorial conflicts or the fear of losing established local images, such as a traditional landscape, which attract tourists. In spite of this, windmills have already appeared on some representations of local landscape (information panels) for tourists. In the interviews we conducted with tourists, we also discovered that some foreign tourists had come to take pictures of wind farms, attracted by their 'powerful image'.

7.6 Conclusions

Our case study is an example of how the development of renewables changes mountain landscapes and landscape values. Throughout the history of hydropower development in our study area, it has been received with contrasting attitudes varying from rejection to acceptance. At the same time, the landscape elements that emerged with it were perceived as negative impacts or alternatively as new landscape values, depending on the historical and socioeconomic context. The analysis of the evolution of hydropower in mountain landscapes and the practices related with it have provided us with useful lessons for understanding the influence of new forms of renewable energy, not only in terms of their landscape impact but also in terms of the role of landscape values in determining their acceptance or rejection by different stakeholders.

Our case study also shows that there is a strong historical link between hydropower development and tourism. Although the most common perception of the relationship between tourism and renewables is that the building of energy infrastructures in a particular area could cause it to lose its attractiveness for tourists, this link is far more complex and some energy infrastructures have in fact contributed to the development of tourism in Sierra Nevada. In the same way, as many industrial landscapes related with hydroelectricity have now become historical landscapes with a significant heritage and tourism value, the emerging renewable power landscapes could themselves become an important part of the local scenery, forming a future 'historic' landscape.

Acknowledgements The authors are grateful to the French government (Research Programme IMR *Ignis Mutat Res*, Project 'Ressources paysagères et ressources énergétiques dans le montagnes sud-européennes') and the Spanish Ministry of the Economy and Competitiveness (CSO2011-23670) for supporting this research.

Bibliography

Abbasi T, Abbasi SA (2011) Small hydro and the environmental implications of its extensive utilization. Renew Sust Energy Re 15(4):2134–2143

Arrojo Agudo P (2004) La Fundación Nueva Cultura del Agua. In: Martínez Gil J (ed) Una Nueva Cultura del Agua para el Guadiana. Fundación Nueva Cultura del Agua & ADENEX, Zaragoza, pp 27–35

Bratrich C, Truffer B, Jorde K, Markard J, Meier W, Peter A, Schneider M, Wehrli B (2004) Green hydropower: a new assessment procedure for river management. River Res Appl 20:865–882

Burrall P (2004) Putting wind farms in their place. Town Country Plann 73(2):60–63

Castillo Martín A (2010) El papel de las surgencias en los regadíos de Sierra Nevada. In: Guzmán Álvarez JR, Navarro Cerrillo R (ed) El agua domesticada. El paisaje de los regadíos de montaña en Andalucía. Agencia Andaluza del Agua, Sevilla, pp 80–84

del Moral L (2000) Problems and trends in water management within the framework of autonomous organization of the Spanish State. In: International Geographical Union, Spanish Committee (ed) Living with diversity, XXIX IGU congress, Seoul, 2000. AGE, Madrid, pp 617–636

Diduck AP, Pratap D, Sinclair AJ, Deane S (2013) Perceptions of impacts, public participation, and learning in the planning assessment and mitigation of two hydroelectric projects in Uttarkhand, India. Land Use Policy 33:170–182

Frolova M (2010) Landscapes, water policy and the evolution of discourses on hydropower in Spain. Landsc Res 35(2):235–257

Frolova M, Pérez Pérez B (2011) New landscape concerns in the development of renewable energy. Projects in South-West Spain. In: Roca Z, Claval P, Agnew J (eds) Landscapes, identities and development. Ashgate, Farnham, pp 389–401

Hadjimichalis C (2003) Imagining rurality in the new Europe and dilemmas for spatial policy. Eur Plan Stud 11:103–113

Hang Bui TM, Schreinemachers P, Berger T (2013) Hydropower development in Vietnam: involuntary resettlement and factors enabling rehabilitation. Land Use Policy 31:536–544

Jiménez Olivencia Y (1991) Los paisajes de Sierra Nevada. Cartografía de los sistemas naturales de una montaña mediterránea. Universidad de Granada, Granada
López-i-Gelats F, Milán MJ, Bartolomé J (2011) Is farming enough in mountain areas? Farm diversification in the Pyrenees. Land Use Policy 28:783–791
McCully P (1996) Silenced rivers – the ecology and politics of large dams. Zed Books, London
Montiel Molina C (2003) Tradición, renovación e innovación en los usos y aprovechamientos en las áreas rurales de montañas. Cuad Geogr 33:7–26
Naredo JM (1997) La Economía del Agua en España. Fundación Argentaria, Madrid
Núñez G (1994) Origen e integración de la industria eléctrica en Andalucía y Badajoz. In: Alcaide J, Bernal AM, García de Enterría E, Martínez-Val JM, Núñez G, Tusell J (eds) Compañía Sevillana de Electricidad. Cien Años de Historia. Fundación Sevillana de Electricidad, Seville, pp 126–159
Núñez G (1998) La hidroelectricidad en pequeña escala. In: Titos M (ed) Historia económica de Granada. Cámara de Comercio, Industria y Navegación, Granada, pp 267–282
Pasqualetti MJ, Gipe P, Righter RW (eds) (2002) Wind power in view: energy landscapes in a crowded world. Academic, San Diego
Saurí D, del Moral L (2001) Recent development in Spanish water policy. Alternatives and conflicts at the end of the hydraulic age. Geoforum 32(3):351–362
Szerszynski B (2005) Nature, technology and the sacred. Blackwell, Oxford
Trillo San José C (2004) Agua, tierra y hombres de Al-Andalus. La dimensión agrícola del mundo nazarí. Grupo de Investigación 'Toponimia, historia y arqueología del Reino de Granada'. AJBAR, Granada
Tzanopoulos J, Kallimanis AS, Bella I, Labriandis L, Sgardelis S, Pantis JD (2011) Agricultural decline and sustainable development on mountain areas in Greece: sustainability assessment of future scenarios. Land Use Policy 28:585–593
Wolsink M (2000) Wind power and the NIMBY-myth: institutional capacity and the limited significant of public support. Renew Energy 21:49–64

Chapter 8
The Nature of Resources

Conflicts of Landscape in the Pyrenees During the Rise of Hydroelectric Power

Serge Briffaud, Emmanuelle Heaulmé, Véronique André-Lamat, Bernard Davasse, and Isabelle Sacareau

Abstract The development of hydroelectricity in the French central Pyrenees at the beginning of the twentieth century was met with strong resistance in the name of landscape preservation and the protection of the tourist resource that landscape represented. Space had to be shared, and some reserves of picturesque features were obtained from the industrialists, in exchange for a free hand in tourist development. This chapter analyses how the interaction between the different stakeholders brought about this spatial partition and shows the ambivalence of the discourse constructed to legitimise it. By examining the case of the protected site of Gavarnie in depth, it sheds light on the social issues that were emerging as a background to the resistance to hydroelectricity and its impact on the landscape and shows how, through this resistance, the power of an external elite acting as a self-proclaimed aesthetic authority was imposed on communities in the mountain areas.

Keywords Hydroelectric power • Mountain landscape history • Landscape preservation • History of landscape representation • History of tourism

Traduit du français par Hilary Koziol and by Nigel Walkington.

S. Briffaud (✉) • E. Heaulmé • B. Davasse • I. Sacareau
ADESS – UMR 5185 CNRS/University of Bordeaux – CEPAGE – ENSAP Bordeaux, Maison des Suds 12 esplanade des Antilles, 33607 Pessac Cedex, France
e-mail: serge.briffaud@bordeaux.archi.fr; emmanuelle.heaulme@bordeaux.archi.fr; bernard.davasse@bordeaux.archi.fr; isacareau@u-bordeaux3.fr

V. André-Lamat
ADESS – UMR 5185 CNRS/University of Bordeaux, Maison des Suds 12 esplanade des Antilles, 33607 Pessac Cedex, France
e-mail: v.andre@ades.cnrs.fr

M. Frolova et al. (eds.), *Renewable Energies and European Landscapes*,
DOI 10.1007/978-94-017-9843-3_8

8.1 Introduction

The arrival around 1900 of a new energy paradigm in the form of hydroelectric power marked a decisive historical watershed for many of Europe's massifs. The development of hydroelectricity brought a degree of industrial modernity to the mountains, but this proved short-lived as, especially after the end of the First World War, the mountains soon became a production area for an energy that could now be transported away to industry in the low-lying plains. Today this separation of energy production and consumption is almost complete, as most of the electrometallurgical and electrochemical factories in the high mountain valleys have been dismantled and reconverted. The mountains are now classified as an 'energy reserve' (according to the terms used in the 1992 Rio Declaration), which can only be exploited and developed through national and transnational networks (Blanc and Bonin 2008; Bonin 2008).

The flow of energy between the mountains and the plains which started at the beginning of the twentieth century was an extremely powerful vector for consolidating the populations and economies of the mountain areas. This was especially so at a time when the mountains were required to satisfy the energy needs of the lowlands and the towns and new opportunities were arising in developing the tourism potential of the high massifs, something to which hydroelectricity made a direct contribution by improving the accessibility and attractiveness of the high mountain areas (Bouneau 1997, 2003; Métailié and Rodriguez 2011; Rodriguez 2012).

It was in this context that, in some European mountain areas at least, a degree of resistance began to emerge to the development of hydroelectric power. From the beginning of the twentieth century, it was argued that landscapes should be preserved in order to protect an important tourism resource. In this study our analysis focuses on the interactions within the landscape/hydropower/tourism triangle and the ambivalence of their construction using the words and actions of those directly involved. We shall demonstrate the key role played by conflictuality, a key component of this construct, by analysing how the different groups of stakeholders tried to project their own action into this space and inscribe their own point of view on the territory, thus revealing different ways of understanding the local conditions that give rise to the development and the formation of an identity.

The case studied here concerns a region in which there was particularly fierce resistance to hydroelectricity: the Bigourdane area of the central Pyrenees and especially the Cauterets valley, the upper valley of the Gave de Pau and its tributaries. As we shall see, the conflicts that occurred here between the period just prior to the First World War and immediately after the Second contributed to creating both spatial and social partitions and in so doing created new socio-spatial relations that were an integral part of a new relationship with resources in the high mountain areas. By socio-spatial relations, we are referring to social relations which take the form of a relationship with space, which are an integral part of it and/or legitimised by it. We are describing a space that illustrates social relations and at the same time also represents the matter, the symbol and the setting for these relations. This research follows on directly from work in recent years on landscape conflicts in general, and on the question of energy in particular, in terms of identity construction and social sharing (Cosgrove et al. 1996; Blanc and Bonin 2008; Labussière 2009; Le Floch and Fortin 2013). It is also linked with studies that have looked at the notion of 'territorial resource' and 'landscape resource' (Di Méo 1988; Gumuchian and Pecqueur 2007; Debarbieux 2001; Dérioz 2004, etc.) and the history of the relationship between societies and the resources specific to mountain areas (Antoine and Milian 2011; Sacareau 2003, 2011; Davasse 2006; Davasse et al. 2012, etc.).

8.2 Landscape, Tourism and Hydroelectricity: An Ambivalent Relationship

The region of the Pyrenees considered in our case study offers an example of the power struggle between those wishing to develop hydropower in the high mountain valleys and those in favour of protecting the landscape above all because of its role as a tourism resource. This section of the mountain chain differed markedly in this respect from virtually all the others, where the growth of this new industry did not stir up the same passions. At first glance, the reason for this difference is obvious: the area around Cauterets, Barèges and Gavarnie is the most popular tourist area in the Pyrenees. It is also the area where the construct of a tourist perception of the landscape (Urry 1990) seems to be most deeply rooted historically, as this mountain range was first 'discovered' as early as the end of the eighteenth century (Briffaud 1994). Here probably more than anywhere else, tourism provided, at least for some (the leaders of the opposition to hydropower), a means of protesting against this manna from heaven that was hydropower, so tempting in the general context of a region hit hard by the decline in the agricultural and industrial economy.

The fact remains that for many reasons the idea that landscape, tourism and hydroelectricity were mutually exclusive was not self-evident. We shall begin by examining why their alleged antagonistic relationship must be seen as the product of the interaction between the stakeholders, who used different registers of discourse or argument. We shall then go on to examine the example of Gavarnie in depth, in order to clarify the circumstances and the motivation behind this construct.

8.2.1 The Rise of Hydroelectricity and 'the Aesthetic-Tourist Obstacle'

From the beginning of the twentieth century, the geographic configuration and the physical and climatic characteristics of the mountain valleys in our study area have offered particularly favourable conditions for exploiting the resources of

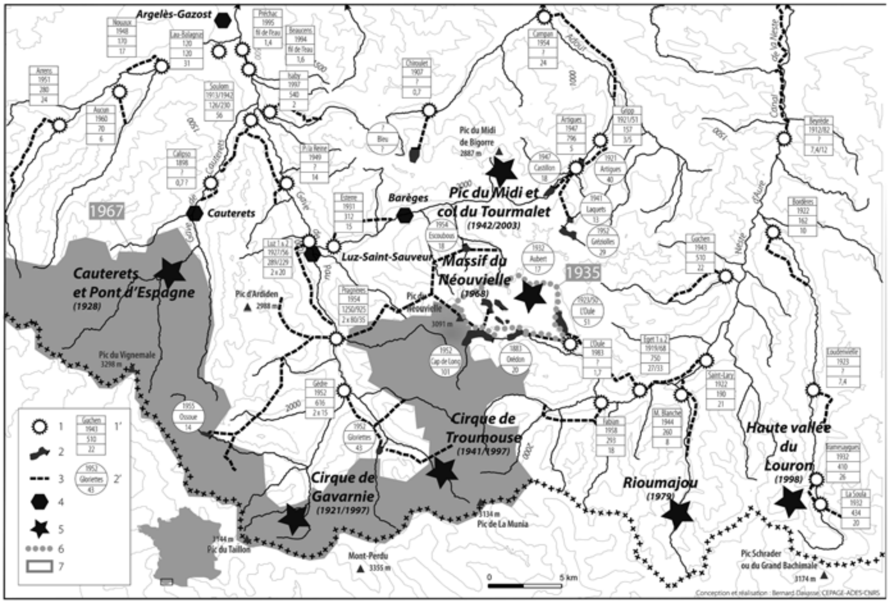

Fig. 8.1 Hydroelectric developments, major protected sites and environmental protection policies in the central Pyrenees (conceived and drawn up by B. Davasse). (*1*) Hydroelectric power station and its characteristics (*1'*): designation, date of entering service, height of waterfall, installed power. (*2*) Reservoir dam and its characteristics (*2'*): date of entering service, designation, height of dam. (*3*) Underground and overground pipe, pressure pipe. (*4*) Spa town. (*5*) Main protected site with creation date. (*6*) Néouvielle Nature Reserve. (*7*) Pyrenees national park

hydroelectric power (Cavaillès 1919). Indeed, the landscapes here have everything likely to gladden the heart of a hydroelectric engineer (steep slopes, large waterfalls, large over-deepened glacial basins and solid locks, glaciers, etc.). There are few lakes but there are plenty nearby, in the granite massif of Néouvielle on the Bareges side and on the Nestes slopes in the upper valley of the Aure; these are on either side of the ridge line that separates the catchment areas of the Adour and the Garonne rivers.

In his report presented in 1948 to the Federation for the Pyrenees Mountain Economy on 'Hydroelectric Development in the Pyrenees, Gave de Pau', the geographer Georges Jorré observed that all this potential was far from being fully exploited (Fig. 8.1). He expressed his disappointment about the absence in previous decades of any global hydroelectric development plan for the valley and regretted that until that point the area had settled for scattered projects, so creating a fragmented disconnected production space, competing power plants and exploiting only a small fraction of the available resources. In Jorré's opinion the problem lay partly in the fact that hydroelectric development in the valley had started too early, 'at a time when the notion of integrated development was unheard of'; however, he believed that the under-exploitation of resources was mainly due to:

> The scale of the aesthetic-tourist obstacle in this region. Of course the hydroelectric engineer is seen everywhere, unjustly so, as a destroyer of wonderful sites, but there are plenty

> of valleys with few visitors where tourism would not upset his plans too much. […] The same is not the case for the Gavarnie area, the Gaube lake, Pont d'Espagne, especially as the splendour of these falls and these lakes provides a good source of income for the local population. It is always difficult to debate with the local authorities…. (Jorre 1948: 316)

This diagnosis was made at a time when plans to develop hydropower plants were being drawn up by EDF (Electricité de France company), which 2 years earlier had become the huge state-owned body to which the country had entrusted its energy future. It was to produce the first global plan to develop the resources in this mountain valley area. The jewel in the crown of the EDF project was the construction of the Pragnères hydropower plant. Opened in 1953, it included a drop of 1,250 m, the highest ever created in the Pyrenees. It also had an ambitious, complex system for the storage and collection of water, which flowed into the power plant via an impressive network of underground penstocks. At Pragnères, water from the reservoirs in the upper valley of the Aure passed through the turbines, as did water from the upper valley of the Gave de Pau, which was stored in the vast Cap-de-Long reservoir perched high in the mountains. Thus water passed from the Garonne catchment area to that of the Adour and vice versa:

> L'obstacle esthético-touristique' did not therefore prevent these ambitious projects from being carried out. Nevertheless, resistance to hydroelectricity, by successfully ensuring that certain sites were respected, played an important part in determining which technical solutions were adopted and which areas were to be turned over to energy production. Hydroelectric engineers were forced to abandon the idea of the Cauterets upper valley, even though its possibilities as a kind of energy Eldorado were plain for all to see; likewise the Gavarnie area, which was just as attractive especially with its spectacular natural waterfalls (including the Great Waterfall in the Cirque which is 423 m. high). These two sites were given protected status in the 1920s and the desire to preserve them from any kind of hydropower development played a key role in the emergence of the first projects to create national parks in the French Pyrenees. The 'Cauterets National Park', protected for almost half a century, can be considered as the template for the Western Pyrenees National Park, created in 1967. (Bobbe 2009)

8.2.2 In the Name of Resources: The Arguments Against Hydropower

What are the criticisms levelled at hydroelectricity?

At first glance there is nothing that could truly be identified as a negative environmental impact, as we would define it today. The idea that it is necessary to preserve the major balances in nature was certainly in evidence in the Pyrenees in the first half of the twentieth century. This idea is deeply rooted in this area and was clearly manifested, as in other mountain regions in Europe, in the struggle against deforestation, the restoration of mountain terrains and the accompanying discourses. Since the end of the eighteenth century, these arguments have focused on how aggressive certain forms of local exploitation of resources can be for the natural environment (Briffaud 1994). In this case the accused were mountain communities, which included both arable and livestock farmers; the accusers were for the most part road engineers, then the foresters, supported by an elite of outsiders, made up primarily of learned travellers who saw themselves as the 'discoverers' of the Pyrenees mountains (Larrere et al. 1981; Kalaora and Savoye 1986; Métailié 1993; Desailly 1990). For a long time, the main justification put forward for carrying out protective and restoration work was in order to cope with catastrophes (floods in the plains, torrential flooding and avalanches in the mountains). However, at a time when strong resistance to hydroelectricity was beginning to be felt in the central Pyrenees, ambitious nature conservation policies were developed with the aim of protecting rare and precious natural environments. The question of the forests still remained a key concern, and the foresters were themselves actively involved in these initiatives. On the Spanish side of the mountain chain, a little to the south of Gavarnie, the Ordesa National Park was created in 1918, with the main aim of protecting the wooded areas against the damage caused by Aragonese shepherds (Berger-Verdenal 1997). A similar argument was put forward by foresters in the same period to support the creation of a national park on the French side (Bobbe 2009), and it was taken up yet again by university researchers in Toulouse and the French Acclimatization Society. Their efforts bore fruit in 1935 with the creation of the Néouvielle Nature Reserve—one of the very first protected areas of this kind in France—where ancient forests of mountain pine were protected against the ravages committed by Spanish shepherds, who had traditionally rented these upland areas for grazing (Chouard 1935).

It is particularly noteworthy that in the first half of the twentieth century, not only did these arguments in favour of nature protection not hinder the hydroelectric cause, but in fact they strongly promoted it and were even used as a justification for it. The idea that the forest could benefit the storage of water in the mountains by enabling it to filter down into the soil and preventing evaporation formed the very basis of the technical argument legitimising mountain land restoration policies. This enabled the forest engineers to gain support for renewed needs for 'houille blanche' (literally white coal—water as an energy resource) and legitimised their strengthening hold on the mountain areas. In a speech given in 1904, the forester L. A. Fabre described the mountain forests as 'white coal deposits' which should be protected as such: 'Surface water concentrated under the plant cover constitutes automatic water reserves. These are deposits of White Coal…'. He went on, 'We must therefore strengthen the repressive and protective nature of the 1882 Law on Mountain Restoration, in order to recover land that has been left for the mountain communities to use at their pleasure', clearly portraying them as the enemies of hydropower.

Objections to hydroelectric development in the mountain valleys therefore came from outside. It could well be claimed that these objections were based on a respect for 'nature' argument, but they were equally based on a defence of what is 'natural' and a rejection of another form of 'denaturation': anything that threatens the 'belle nature' that could be admired in the most famous landscapes of the Pyrenees. This nature is also a resource in that it attracts tourists to the mountains, and this is the first good reason that was put forward in favour of the call for its protection. In this region of the Pyrenees renowned for its thermal springs, tourism resources consisted partly of the virtues of an environment—or rather of a 'climate', in the Hippocratic sense of the term—which together formed a preventative and therapeutic whole. In 1942, the Medical Society of Cauterets stated that they feared that hydroelectric development would alter the 'hygrometry of the atmosphere at the spa resort which was maintained by the continuous mixing of layers of air from the valley, which were fanned by the current of air from the mountain stream, which in turn renewed and moistened the air to the greater benefit of the patient's airways, a perfect complement to the cure and the vapours inhaled from the springs'. But also and above all, they expressed their fear of the effects that developing the upper valleys might have on the thermal springs themselves.

Landscape is among other things a tourist resource must protect, and protecting it against invasion by hydroelectric infrastructures is first and foremost protecting a picturesque resource with economic potential. As for the aesthetic argument, it in fact also seems to have been woven into this pro-tourism argument. The main source of concern was the waterfalls: in Cauterets, for example, there were the Cérisey, Pont d'Espagne and Lutour falls, which for almost 200 years had drawn crowds of people to take the curative waters. The 'hardware', such as the penstocks, was talked about less often and less often still the unsightliness of the dams.

Through the various forms of resistance to hydroelectricity, the concept of a landscape resource was confirmed as an essential item at the heart of the debate about the economic development of the mountain regions. In addition, and above all, it was concepts of landscape associated with tourism 'resourcing' and the aesthetic aspects thereof which, as we shall see, penetrated to the very heart of social relations with the resources. Exploiting the hydroelectric resources, therefore, consisted not only of dealing with concern for the quality of the landscapes and tourist development: very early on, driven by the resistance they encountered, hydroelectric promoters incorporated these objectives, the aesthetic dimension included, as one of the aspects of production to which all plants should aspire.

8.2.3 Hydroelectricity and Landscape Values: Tensions and Contradictions

The ambivalence of relations between hydroelectricity and tourism seems, at least in part, to be sustained by the fact that the hydroelectric engineer's and the tourist's perception of landscapes coincide in many significant ways. For both of them, the attractiveness of a site is based, in part at least, on the same features—above all the lake and the waterfall. The differing expectations associated with these features are not necessarily contradictory. Hydroelectric infrastructure can be seen as the judicious exploitation of landscape potential and thus as a factor that can improve the picturesque nature of a site. Very early on, to counter accusations of vandalism, the promoters of hydroelectricity emphasised their role as creators of high-quality landscapes. In this respect, they were following the tradition upheld in particular by French highway engineers, whereby any civil engineering structure was a means to display and to exalt natural beauty (Picon 1988). Hydroelectric engineers have also been known occasionally to boast of increasing natural beauty by imitating it. In 1913, a contributor to the hydroelectric engineers' journal, *La Houille Blanche*, spoke of the creation of an 'admirable waterfall' to refer to the effect produced by the water as it rushed down the overflow spillways from the chambers above the powerhouse, 'but informed by their shared passion, academics and passing tourists exclaim while pointing to the cascade, 'here's one that the vandals haven't managed to steal from us yet' (Bougault 1913: 66).

Clearly, however, when trying to prove their contribution to enhancing the mountains and increasing their attractiveness to tourists, those promoting hydroelectricity focused primarily on the creation of reservoirs. In many respects, the hydroelectric engineer and the tourist appear to agree about the value of the reservoir as a feature of the landscape. In travellers' tales and guidebooks and particularly in lithographs and postcards, lakes transmit an image of a landscape at peace. The power of the mountains—embodied in the surrounding summits, the steep escarpments and the rock slides produced by erosion and carried down by gravity—seems to be extinguished in the large, still expanses of water in which they are reflected. For generations of travellers, the mountain lake represents the calm at the centre of a storm, a peaceful place in a hyperactive environment. It is the archetypal sublime spectacle—an oxymoron landscape that simultaneously transmits two conflicting sensations. But it can also be viewed as a concentration of these forces, which are being held in reserve but which, at any moment, may be mobilised into action. From the end of the eighteenth century in the Pyrenees, people found the phenomenon of the sudden draining of high-altitude lakes both interesting and fascinating. The pioneering 'discoverers' of the mountain chain thought that it provided a major insight into the formation of relief in the valleys (Briffaud 1989), before glacial theory extended this idea to considering the lake as a relic of the natural forces responsible for shaping the landscape in these regions. Clearly, the hydroelectric engineer's lake, through the dual functions assigned to it of regulation and storage, has this same ambivalent nature. The hydroelectric reservoir both channels and concentrates energy from the mountains. It can also be used for redistribution of water resources, regulating their irregular, often unpredictable, time scales. And even if the engineer has to resort to artifice by creating a lake, sometimes from scratch, he is nonetheless 'creating', in the same action, potential specific to the mountain environment—including aesthetic potential.

And there is more, in that the naturalness which in this case technical artifice can claim to produce also requires that the creation of a new 'lake' be seen as returning things to their original state, almost a recreation or at least a restoration of nature that had long disappeared. Indeed, the idea that lakes are a transient environment, destined at some point to close up and run dry, was particularly prevalent at the beginning of the twentieth century, a period that saw considerable development in biogeography and biology in relation to environmental dynamic 'laws'. The young Raymond Ritter, a key figure in the fight against hydroelectricity in the Pyrenees from the 1920s to the beginning of the 1970s, made this fairly indulgent comment about the role of the engineer in re-creating lost lakes:

> In the future especially, in order to electrify the Midi railway network, more dams will help to accumulate immense reserves of hydroelectricity and will doubtless also revive some

lakes that have disappeared. Thus the needs of our civilisation conspire, by the most surprising paradox, to take nature back thousands of years into the past. (Ritter 1924: 164)

The lake is therefore the engineer's redemption, and his penstocks, powerhouses and unsightly pylons can be forgiven, provided that, by creating lakes, he achieves this return to some lost original nature. And the reservoirs did indeed attract. The many dams built in the Néouvielle massif, and in particular the one at Cap-de-Long, have created major new tourist attractions in the part of the Pyrenees studied here. When the building work was finished, there were plans to use infrastructure bequeathed by EDF to provide a 'lake road', which would start from the upper valley of the Aure to the Bastan valley. The project was later abandoned, but the great artificial lake behind the Cap-de-Long dam nevertheless attracted considerable crowds from the very beginning (Fig. 8.2).

From the post-Second World War period to the time when the development of hydroelectric power in the mountains moved up a gear, the engineer's aesthetic ambitions were also expressed in other ways and sometimes took the form of a resounding tribute to modernity. In the Pyrenees, the hydropower plant at Pragneres and its great waterfall have been described by executives at EDF as an authentic tourist attraction:

The Pragneres-Cap-de-Long waterfall is not an energy source; it is a spectacular site. Cap-de-Long on the road to the Lakes and Pragneres on the Gavarnie road are already international tourist resorts. This waterfall has a two-fold purpose and represents a work of engineering that must be completed, in a spirit of national solidarity, as the most beautiful lake setting in these mountains, and as the most splendid and one of the most powerful power plants in France. (Dubon, cited by Dupont 1955)

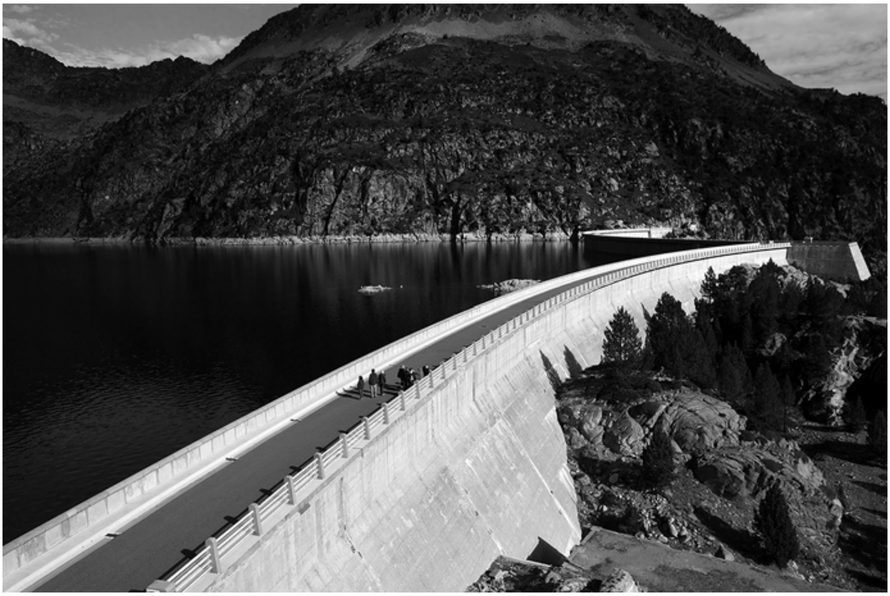

Fig. 8.2 The Cap-de-Long Dam in the granite massif of Néouvielle (Hautes-Pyrénées) (Photo S. Briffaud)

So far it was clearly the Promethean nature of these structures that was being promoted, providing a source of new value for the mountain region, in which sublime engineering skills could enhance and accentuate the sublime natural beauty of these places.

The initial apparent contradiction between tourism and the exploitation of hydroelectric resources grows even smaller when one considers the contribution this resource has made to improving the accessibility to the mountain chain, to developing tourist infrastructure in general and to providing better facilities. This role of hydroelectricity in tourism development was very quickly enshrined in law. Article 10 of the Law of 16 October 1919 on the use of hydraulic energy stipulated that project specifications must give details of measures for 'the protection of landscapes and the development of tourism'. In 1925 the Great Exhibition held in Grenoble on 'hydroelectric power and tourism' would provide an opportunity to celebrate the extent to which these two types of development in mountain regions complemented each other.

This complementarity is clearly visible in certain Pyrenean valleys as can be seen in studies by Jean-François Rodriguez (2012). These valleys were the first in the chain to have an electric tramway service (the PCL—Pierrefitte-Cauterets-Luz), which was at one time planned to be extended as far as Gavarnie. The line to Cauterets was opened in 1900, 4 years after the spa town had been equipped with electric lighting. Thus hydroelectricity contributed to the development of tourism in this part of the Pyrenees even before the First World War. With electrification came the construction between the wars of the first ski lifts (a cable car from Lys to Cauterets in 1936 and a funicular railway from Lienz to Barèges in 1937) which opened up the Pyrenees to skiing and led to an increase in the number of tourists (16,975 people took the waters at Cauterets in 1937). The contribution of hydroelectricity was to be even greater after 1945 with the creation of ski slopes on either side of the Col du Tourmalet. In 1946 the first ski lift in the Pyrenees was built at La Mongie; in 1949, at Barèges, EDF contributed directly to extending the funicular railway at Lienz by constructing a cable car for building works out towards Glère, serving the ski slope at Ayré, the longest in the Pyrenees. EDF also helped set up a new type of landscape, which of the skiable areas at the ski resorts scattered with pylons, cables and later snow cannons. The industrial nature of the landscape fades when it is associated with snow and skiing, but it can shock in summer when the snow has melted and the ski lifts stand idle.

8.3 The Case of Gavarnie: The 'Pyreneists' Against 'the Valley'

The 'aesthetic-tourism obstacle' did nevertheless arise in this part of the Pyrenees against the engineers' ambitions, and space had to be shared—energy on one side and beautiful landscapes on the other. Why did this happen? If one were to reply by

Fig. 8.3 The Cirque of Gavarnie and (below on the *left*) the basin of La Prade (Photo S. Briffaud)

simply stressing the great importance of tourism for the economy of these valleys that would be to admit that there is necessarily a contradiction between tourism and hydroelectricity. As we have just seen, things are not that simple. In order to understand the sharing of space that is required here, we need a more in-depth analysis of this 'landscape' resistance and of the games between the stakeholders that were played out around it. We then discover that as a background to this spatial division, a social division was also designed, which was inextricably linked with the changes in the perception of what mountain resources are, indeed of the very nature thereof.

This in particular is what we learn from an analysis of the landscape conflicts caused by the Gavarnie site (Fig. 8.3).

8.3.1 The Story of the Protection of Gavarnie

Opposition to the construction of hydroelectric infrastructure in the Pyrenees first appeared in 1913 in relation to the famous Cirque de Gavarnie site. The Commission Syndicale de la Vallée de Barèges (CSVB) (Syndicate Commission for the Barèges Valley), which held some riparian rights in the valley areas that it managed, agreed at a meeting on 23 November 1912 to assign to a man from Tarbes the rights that it held for the Gavarnie mountain streams (which corresponded to the part of the Gave de Pau that was nearest to its source) and the Héas streams (where the waters come from another renowned glacial Cirque, the Troumouse).

Some weeks after the concession agreement, however, adverse reactions began to be heard and soon became increasingly indignant (A.D. 65, S. 535). The two largest associations that had been promoting tourism development in mountain regions during this period, the Club Alpin Français (CAF) and the Touring Club de France (TCF), were the first to apply to the Prefect of the Hautes-Pyrénées department to protest against the attitude of the CSVB. The CAF asked that measures be taken for the 'protection of sites that were renowned throughout the world which represent part of France's natural treasures' (Anonymous 1913: 109). Next it was the turn of the Société pour la Protection des Paysages de France (SPPF) (Society for the Protection of French Landscapes) to urge the Prefect to organise a consultation with the Departmental Commission for Natural Sites and Monuments for their opinion on the protection of the Gavarnie site under the terms of the Law of 1906. The response was favourable and the Prefect reassured the Minister for Education, the focus of all the lobbying and protest activities by the different associations, as to his willingness to act as a guarantor of respect for these sites. However, the reaction that really made the protection of Gavarnie a great national issue came in the form of an article published in Le Figaro by Pierre Loti, on 27 January 1913. Although clearly with little or no accurate information on the exact nature of the threat, the author of *Ramuntcho* took the stance of the old prophetic sage whose advice was doomed to be ignored:

> I am finally growing tired of always being the voice crying out in the wilderness against modern barbarism, and I believe that people are now growing tired of hearing me. […] However, this warning cry has reached me today from the Pyrenees, along with a fervent prayer that I can make it heard as far as my voice will carry. A 'Valley Syndicate' is in negotiations to sell all the waterfalls in the Gavarnie valley to a finance company […]. We have already witnessed these savages who are selling off all the ancient treasures from our country churches to the Americans; we have seen these black bands of speculators who are blowing up our rocks and cutting down our age old forests. And now we have the Cirque de Gavarnie, one of the legendary natural wonders of France, the Cirque de Gavarnie which tomorrow will be destroyed simply to fill the pockets of a few rogues! […] We protect monuments, why can we not also protect landscapes, waterfalls? […] One day, there'll be no one left to rise up with sticks and pitchforks to lynch these rascals!

It is interesting to note that Loti appeared to know nothing of the 1906 law, which did indeed allow for landscapes and waterfalls to be protected.

This article helped to trigger a general mobilisation against the vandalism associated with hydroelectricity, making the year 1913, which had already seen various actions for the protection of nature, particularly tumultuous (Jaffeux 2010). Two other projects (in the Guil valley in the Queyras and the Loue valley in the Jura) to harness water as a driving force also produced some very strong reactions. In the 1913 issue of La Montagne, the national journal of the CAF, the speleologist Edouard-Albert Martel listed these two sites alongside Gavarnie as areas that could potentially become national parks (Martel 1913). The problem of the negative impacts of hydroelectricity soon reached the French Parliament when in a session on 13 March 1913 at the Palais Bourbon, and it emerged that the major tourist associations, with the support of certain Members of Parliament, wanted to pit tourism against hydroelectricity as conflicting options. As a result an amendment was passed to the Finance Law of 8 April 1898 which stated in relation to hydroelectric development that an order must be issued by the Prefect to determine 'the necessary conditions for the protection of the landscapes and in particular would stipulate the minimum flow that was to be left in these water-courses during the tourist season'. This was the second time that the word 'paysage' (landscape) appeared in the body of French Law. The first instance had been in a text relating to electricity in Article 19 of the Law of 15 June 1906, which mentioned 'the technical conditions that energy distribution must satisfy in terms of the safety of the individuals and the public services concerned, and regarding the protection of the landscapes'.

Many projects for producing hydroelectricity in Gavarnie were put forward both during and after the war. The most ambitious was presented in 1919 by the company that owned the electrochemical factory in Soulom, in the Argelès basin. They proposed to create a reservoir between the hamlet of Gavarnie and the Cirque, in the La Prade basin, capable of supplying two power stations lower down the valleys (one at Gèdre and one at Luz). At that point, the indignation machine once again leapt into action, and the large tourist associations entered the fray. High-profile individuals with moral authority and with a strong political influence rushed to their aid: Prince Albert I of Monaco (Damien 1964) and the geographer Franz Schrader, who at the turn of the twentieth century had been the main inspiration behind maintaining a link between 'Pyreneism', the practice of scholarly exploration and the contemporary scientific movement. This time the local population joined the debate, and the Gavarnie Municipal Council requested that the site be given official protection. This was probably due, in the first instance, to their concern that access to the Cirque might be taken over by a private company, as the hiring out of donkeys and horses to tourists was still the main economic activity in the commune.

The site was eventually protected on 20 July 1921 and Gavarnie would never again be affected by hydroelectric development. However, even after the Second World War, a number of projects were resurrected, as shown in these lines by Georges Jorré, in which we see once again a reference to the project for a dam which would transform the 'oule' at La Prade into a reservoir:

> In Gavarnie itself, there are abundant supplies of 'white coal', and it would be perfectly possible to develop the Cirque, and also the one at Troumouse. But […] how can we persuade public opinion to accept the 'bottling' of the Gavarnie waterfall […]? What would perhaps be feasible would be the partial conversion of the Oule into an 11,000,000 m3 reservoir; a dam would reform the ancient lake at La Prade. […] some are even inclined to believe that the existence of a lake would enhance the beauty of the Cirque even more. (Jorre 1948: 313)

8.3.2 The Case of the La Prade Reservoir

This last assertion brings us to an event in the history of the site following its classification as a protected area, which sheds light on the issues in the debate surrounding its protection. At the end of 1934, the CSVB accepted the offer from a 'tourist development company' to build toll roads to the cirques at Gavarnie (from the hamlet) and Troumouse (from the village of Gèdre). The protest machine immediately leapt into action against this road-building project, just as it had done earlier when hydroelectric projects were proposed. Tourist associations and other tourist boards were in the front line. The landscape protection banner was raised and the same arguments about maintaining the 'integrity of the site' were rolled out once again.

The similarity in these processes, and the fact that both resulted in projects being rejected despite having very dissimilar effects on the landscape, raises questions because it cannot be explained simply by a desire to reject all forms of development in the name of preserving the virginity of the landscapes. This time, the opponents immediately put forward their own development project, which seemed potentially to have a much greater impact on the site than the original project. The designer of this alternative project, behind whom the defenders of beautiful landscapes immediately fell into line in large numbers, was Louis Le Bondidier (Le Bondidier 1935), a well-known 'Pyreneist', president of the Commission on sites in the Hautes-Pyrénées and of the Union of Tourist Boards of the South-West France, founder of the Pyrenean Museum in Lourdes and a key figure in all the campaigns for the protection of Cauterets and Gavarnie since before the war. However, at the heart of the project was the construction of a dam which would enable the glacial depression at La Prade to be filled, in other words a sort of recreation—although obviously not claimed as such—of the landscape that would have resulted had the hydroelectric project that was rejected as a result of the 1921 classification been carried out. The reservoir was to be linked to the village by a road suitable for vehicles and to the Cirque by mule track. This time, the idea put forward 15 years previously that such a project could violate the aesthetics of the site was vehemently rejected. Instead, the reservoir was presented as helping to strengthen the picturesque character of the Cirque and increasing its attractiveness for tourists. Its 'naturalness' was stressed, and an argument was used that could have worked just as well in favour of hydroelectric projects, namely, the return of the valley to its original state by reconstituting a disappeared lakeside landscape.

The affair of the Gavarnie toll road and the La Prade reservoir reveals the real motives behind the declared aim of preserving the landscape: the fight to control tourism development and income. The struggle brought the two groups into conflict. On one side was the Syndicate Commission, which, in theory at least, represented the interests of 'the valley' and tried—in the case of hydroelectric projects such as the toll road—to gain support from private investors and collect income from tourism in the areas which it managed and on the other were the associations, representing aesthetic authority and developmental power, with strong connections to the political and cultural world of Paris and with the backing of some of the local elite. The practice of Pyreneism, with its particular codes and the recognition that came with it, united and structured this group, above and beyond any possible divisions between outsiders and locals. In fact it conferred a sort of certificate of Pyreneity on a non-resident or new-inhabitant elite, which gave them the right to speak out on local affairs and took advantage of the aura that still surrounded the figure of the mountain 'explorer'. 'Gentlemen Pyreneists' were the ironic form of address used in these polemics to refer to those who made up this group by the others who referred to themselves as ‘Barégeois’ or as ‘Toys’. These two expressions refer to the administrative area in the Barèges valley, which grouped several valleys together and which was officially represented by, and only by, the Syndicate Commission. In the local dialect, the word ‘toy’ originally meant ‘young man’ or ‘little man’, and in Piedmont it referred to mountain people or shepherds (Lespy and Raymond 1887). The use of Barégeois to refer to an ‘inhabitant of the Barèges valley’ was a neologism, which seems to have appeared at the time of the events described here, when in relation to the question of landscapes another form of authority was asserting itself over the area, legitimised by a power based on sensitivity and aesthetics.

The tension between these two groups reached its height around the time of the affair of the toll road and the La Prade lake. It was at this point that the issue of common ownership was called into question, and through this the local communities' capacity to manage their own territory was challenged. One opponent of the CSVB project, the geographer and Pyreneist Maurice Heid, had no hesitation in affirming in relation to the Syndicate Commission in a letter of support to Le Bondidier that ‘… the rights that these false communities have been brandishing for centuries are in fact rights that have been usurped’. A complaint, which would not be upheld, was therefore brought against the CSVB at the court of Tarbes. The commune of Gavarnie, which called for a project that was threatening the interests of local traders to be abandoned, then immediately defected to the ‘valley’ camp by deciding—a major act of transgression viewed from the local context—to request to withdraw from the common rights' indivisibility arrangement (which was then refused by the courts). The resulting disunity in ‘the valley’ was therefore evident and went right to the very heart of the Syndicate Commission. The Commission split apart over this project, which was supported by the Chairman for reasons that some members considered too closely linked with his own personal interests.

In the end, in 1937 the Sites Commission accepted in principle the creation of the La Prade lake and a cable car enabling tourists, after crossing the lake on small boats, to cross the last barrier separating them from the Cirque itself. This last construction seemed to be a modest concession to the CSVB. Indeed, it was part of a project that they had supported and which retained the idea of a lake and consisted of constructing two cable cars and a railway overhanging the lake to take tourists to the Cirque. And although, with the outbreak of war, none of these projects was completed, the discussions that they sparked off certainly helped shape the social landscape in this region of the Pyrenees.

8.4 By Way of Conclusion

The preceding analyses show that the emergence, in this region of the Pyrenees, of what can be called a ‘landscape paradigm’ can be attributed to the rapid expansion of hydroelectricity. This paradigm can be seen as a prism through which the value in heritage terms of spaces and exploitable resources begins to be perceived and discussed. This landscape prism was not set up to replace a pre-existing paradigm but appeared alongside it. This earlier paradigm can be described, without anachronism, as environmental, in the sense that its existence is inseparable from the discourse on the destruction of natural balances and the need to regulate—mainly managed, as we have seen, by forestry policies—the nature/society relationship. Since the beginning of the twentieth century, a dual approach to the question of protecting these mountain areas has emerged in relation to the opportunities for the mountain regions opened up by hydroelectricity production. This approach is based on these two differing points of view, namely, the environment and the landscape, leading to a constant back and forth between these two paradigms whose characteristics and availability then go on to fuel a complex social interplay, giving rise to representations that differ not only as a result of a diversity in sensitivities or interests, but also because they are grounded on fundamentally dissimilar ways of understanding reality.

If we view the question through the landscape prism, the value of mountain spaces and their associated resources must be considered through the double filter of their aesthetics and their attractiveness to tourists. The protection of spaces to prevent hydroelectric development corresponds to issues of this type. The spatial division that is created is not the same as that which results from a protection policy founded on the environmental paradigm. Without doubt, protection policies fuelled by these two sources are based first of all, —apart from an exceptional case where some small valleys within the Néouvielle Nature Reserve were totally set aside—on the separation between the two forms of development and the exploitation of the resource. Approaching protection via the environmental prism at this time mainly involved preventing the expansion of agriculture, silviculture and livestock grazing in favour of forestry management (and sometimes, as in Néouvielle, hydroelectricity), whereas applying the landscape prism involves the exclusion of hydroelectric and industrial modernity, which should leave the way open for tourism to develop. However, the boundary around spaces protected in the name of the landscape separates only secondarily what is natural from what is not, since from a landscape point of view, nature is only a function of beauty or the picturesque. The boundary line is therefore much more difficult to define and eminently negotiable. Certain arguments that appear to justify it are sometimes perfectly reversible and can be used just as well to justify the views of two aesthetic opponents. We have seen this in particular in relation to the reservoir, which was initially denounced as a shameful artifice that the Promethean ambitions of the engineer sought to impose on the landscape, before seamlessly being transformed into an expression of belle nature and picturesque invention. No decree of naturalness, such as those produced by the sciences, can bring the debate to an end here. Only a decree of aesthetics, which is more discretionary, could do so, and what it above all claims to impose is a certain perception of modernity: of the resources it produces and the values it constructs.

The boundary beyond which hydroelectric development is constrained in the mountain areas in fact only exists ultimately in relation to the affirmation of an aesthetic authority claimed by a social group whose identity is forged around the onlooker gaze adopted by its members and which justifies through this knowledge experience, the share of income, both material and symbolic, which it extracts from the mountain areas.

With the energy transformation during the first decades of the twentieth century, landscape and environment have become the two objects through which the perception of the resource and the rights to access and exploit it are reconstructed. Both are based on expert opinions, one founded in the natural sciences and the other in the aesthetic sense. An acknowledgement of the ability to distinguish between true and false and beautiful and ugly is the condition which legitimises dividing space with a view to protection. But beyond the boundaries of what is protected, whichever prism the authority claims to be applying, it is the mountain societies themselves, who, whether it is nature or tourist resources that are finally preserved and will always be denied the ability to decide by themselves and for their own benefit as to the use and value of the resources.

Acknowledgements The authors are grateful to the French government for supporting this research framed by the project 'Ressources paysagères et ressources énergétiques dans le montagnes sud-européennes' within the Research programme IMR *Ignis mutat Res*.

References

Anonymous (1913) Un voeu du club alpin en faveur des sites menacés de Gavarnie et Héas. La montagne, revue mensuelle du Club Alpin Français 9:109

Antoine JM, Milian J (eds) (2011) La ressource en montagne. Entre potentialités et contraintes. L'Harmattan, Paris

Berger-Verdenal M (1997) Briet et le parc national d'Ordesa. Pyrénées 191:113–120

Blanc N, Bonin S (eds) (2008) Grands barrages et habitants: les risques sociaux du développement, Fondation de la Maison des sciences de l'homme. Éditions Quae, Paris

Bobbe S (2009) Il était une fois un parc… Histoire de la création du Parc national des pyrénées. In: Larrère R, Lizet B, Berlan-Darqué M (eds) Histoire des parcs nationaux. Comment prendre soin de la nature? Éditions Quae, Paris, pp 95–109

Bonin S (2008) Les barrages: vers de nouveaux enjeux pour la montagne. Rev Géogr Alpine 96(1):5–7

Bougault P (1913) Le tourisme et la houille blanche devant la chambre des députés. La Houille Blanche 12(3):65–70

Bouneau C (1997) Modernisation et territoire. L'électrification du grand sud-ouest de la fin du XIXème siècle à 1946. Fédération historique du sud-ouest, Bordeaux

Bouneau C (2003) La construction et les mutations de l'économie touristique pyrénéenne du milieu du XIXème siècle au second conflit mondial. In: Construction d'une industrie touristique aux XIXème et XXème siècles. Perspectives internationales, ed l. Tissot, Alphil, Neuchâtel, pp 127-144

Briffaud S (1989) L'invention géologique du paysage pyrénéen à la fin du XVIIIème siècle. Rev Synth IV(3–4):419–452

Briffaud S (1994) Naissance d'un paysage. La montagne pyrénéenne à la croisée des regards, XVIème-XIXème siècle. Université de Toulouse II et Archives départementales des Hautes-Pyrénées, Toulouse Tarbes

Cavaillès H (1919) La houille blanche dans les pyrénées françaises. Ann Géogr 156:425–468

Chouard P (1935) Les réserves naturelles aux pyrénées. Création de la réserve du néouvielle. Annales de la fédération pyrénéenne d'économie montagnarde IV:30–48
Cosgrove D, Roscoe B, Rycroft S (1996) Landscape and identity at ladybower reservoir and rutland water. Trans Inst Br Geogr 21(3):534–551
Damien R (1964) Albert 1er, prince souverain de monaco précédé de l'historique des origines de Monaco et de la dynastie des Grimaldi. Institut de Valois, Paris
Davasse B (2006) La gestion sociale des ressources naturelles dans les espaces sylvo-pastoraux des Pyrénées de l'est (du moyen âge au siècle actuel). In: Beck C, Luginbühl Y, Muxart T (eds) Temps et espaces des crises de l'environnement. Editions Quæ, Paris, pp 211–225
Davasse B, Briffaud S, Carré J, Henry D, Rodriguez J-F (2012) L'observation environnementale au prisme du paysage. Dynamiques paysagères, actions territoriales et représentations socio-spatiales dans le territoire de l'OHM Pyrénées Haut-Vicdessos. Sud-Ouest Européen 33:57–68
Debarbieux B (2001) Les montagnes: représentations et constructions culturelles. In: Veyret Y (ed) Les montagnes. Discours et enjeux géographiques. SEDES, Paris, pp 1–34
Dérioz P (2004) Le paysage, une ressource territoriale emblématique, mais ambigüe. Montagnes Méditerranéennes 20:155–163
Desailly B (1990) Crues et inondations en roussillon. Le risque et l'aménagement. Fin du XVIIème-milieu du XXème siècle. Thèse de doctorat de géographie, Université de Toulouse-le Mirail, Toulouse
Di Méo G (1988) Géographie sociale et territoires. Nathan, Paris
Dupont G (1955) La mise en valeur des vallées de Luz et de Barèges et la contribution d'EDF. La nouvelle république des pyrénées, April 28
Gumuchian H, Pecqueur B (eds) (2007) La ressource territoriale. Economica, Paris
Jaffeux H (2010) La longue et passionnante histoire des parcs nationux français. Pour Mémoire 9:138–163
Jorre G (1948) L'aménagement hydroélectrique du Gave de Pau pyrénéen. Annales de la fédération pyrénéenne d'économie montagnarde XII:293–318
Kalaora B, Savoye A (1986) La forêt pacifiée: les forestiers de l'école de le play, experts des sociétés pastorales. L'Harmattan, Paris
Labussière O (2009) Les stratégies esthétiques dans la contestation des projets d'aménagement: le milieu géographique entre singularité et exception. L'information Géogr 2:68–88
Larrere R et al (1981) Forestiers et paysans. Les reboisements en montagne depuis l'empire. Recherches 45:57–84
Le Bondidier L (1935) Le problème des voies d'accès au cirque de Gavarnie. Une solution: le lac du Marboré. Imprimerie Louis Jean, Gap
Le Floch S, Fortin M-J (2013) Les paysages d'éole à l'épreuve du développement durable: où accepter n'est pas toujours participer. In: Lüginbühl Y, Terrasson D (eds) Paysage et développement durable. Quæ, Paris, pp 219–234
Lespy V, Raymond P (1887) Dictionnaire béarnais ancien et moderne. Imprimerie centrale du Midi, Montpellier
Martel E-A (1913) La question des parcs nationaux en france. La montagne 7:401–412 and 8:433–457
Métailié J-P (ed) (1993) Risques et aménagement dans les pyrénées: actes du colloque international tenu à foix et à pau, les 30–31 mai 1990 et 8–9 juin 1990. GDR-Isard 881-CNRS, Toulouse
Métailié J-P, Rodriguez J-F (2011) Du paysage de la ressource au paysage du ressourcement. In: Antoine J-M, Milian J (eds) La ressource en montagne. Entre potentialités et contraintes. L'Harmattan, Paris, pp 213–231
Picon A (1988) Architectes et ingénieurs au siècle des lumières. Editions Parenthèses, Marseille
Ritter R (1924) La vie et la mort des lacs pyrénéens. L'illustration, pp 163–164
Rodriguez J-F (2012) Paysages de l'hydroélectricité et développement touristique dans les pyrénées. De la ressource naturelle au patrimoine culturel. Revue de géographie alpine 100(2). Url: http://rga.revues.org/1805. doi:10.4000/rga.1805

Sacareau I (2003) La montagne. Une approche géographique. Belin, Paris

Sacareau I (2011) Lorsque les pratiques touristiques renouvellent la ressource. In: Antoine J-M, Milian J (eds) La ressource en montagne. Entre potentialités et contraintes. L'Harmattan, Paris, pp 213–231

Urry J (1990) The tourist gaze. Leisure and travel in contemporary societies. Sage Publications, London

Chapter 9
Hydropower Exploitation in the Piave River Basin (Italian Eastern Alps)

A Critical Reading Through Landscape

Viviana Ferrario and Benedetta Castiglioni

Abstract Renewable energies have been one of the main driving forces of European landscape change in the last ten years. Despite its acknowledged contribution to sustainable development, 'renewable' is not ipso facto 'sustainable': on the contrary renewable energies can have negative impacts and create both environmental and social conflicts. Landscape is often at the heart of these conflicts, both as an asset to protect and as a tool for use in debate. This situation leads us to reflect on the question of 'landscapes of energy'. This paper investigates the relationships between energy production and the territory, using landscape as a tool for a critical review of past and current hydropower exploitation in the Piave river basin, in the Italian Eastern Alps. Regional policies and local practices related with the development of small hydropower plants are analysed from the point of view of the strategies, values and meanings expressed by the different stakeholders. The analysis reveals various weaknesses of the policies and the practices that undermine the objective of integrating energy into the landscape.

Keywords Energy landscape • Hydropower exploitation • Landscape reading • Alpine landscape • North-eastern Alps

V. Ferrario (✉)
Dipartimento di Culture del Progetto, Università Iuav di Venezia, Dorsoduro 2196 (Ex Cotonificio), 30123 Venice, Italy
e-mail: viviana.ferrario@iuav.it

B. Castiglioni
Dipartimento di Scienze Storiche, Geografiche e dell'Antichità – sez. di Geografia, Università di Padova, via del Santo, 26, 35123 Padova, Italy
e-mail: etta.castiglioni@unipd.it

M. Frolova et al. (eds.), *Renewable Energies and European Landscapes*,
DOI 10.1007/978-94-017-9843-3_9

9.1 Introduction

9.1.1 Landscapes of Energy

Renewable energies have been one of the main driving forces of European landscape change in the last ten years. These new landscapes are not always easily or well accepted. On the contrary renewable energy projects and constructions often lead to conflicts. Despite its acknowledged contribution to sustainable development, renewable and sustainable are not synonymous, and renewable energy plants can have negative impacts from both an environmental and a societal perspective (Abbasi and Abbasi 2000; Wüstenhagen et al. 2007; Murphy 2012). The lack of social acceptance can often be an obstacle, slowing down the implementation of energy policies (Wolsink 2007b; Wüstenhagen et al. 2007).

Landscape is often at the heart of these conflicts, generally as something to be protected from change when its visual appearance is at risk from new plants, as happens in the case of wind power (Wolsink 2007a; Slee et al. 2011) and energy transportation infrastructures (Malesios and Arabatzis 2010). 'Landscape conflicts' happen when a social conflict explodes because of a landscape threatened by a transformation project (O'Neill and Walsh 2000; Davodeau 2008). The conflict refers both to 'what the future of the landscapes ought to be and who has an entitlement to have a legitimate say in coming to a decision about that question' (O'Neill and Walsh 2000). Landscape conflict arises whenever two or more different ideas of landscape coexist in the same territory, explicitly or implicitly expressed by different population groups (Ferrario 2012), so creating questions of power and justice in decision making (Olwig and Mitchell 2007).

Mountain areas are a very good example of large landscape change due to energy exploitation. Hydropower development started in the European mountains at the end of the nineteenth century and – with differences from country to country – continued throughout the twentieth. Many mountain valleys were transformed into large lakes thanks to the building of high dams; entire villages vanished; the local people had to adapt their lives or move away; the local climate changed. In the Alpine region these radical transformations, generally sought by stakeholders from outside the area, were not always accepted and in many cases produced social conflicts and environmental impact (Crook 2001; Girel et al. 1997; Romerio 2008). They also played their part in some famous disasters, including among others the ones of Drance (1818), Gleno (1923) and Vajont (1963). Since the 1970s, large dams 'have suffered from more general criticism relating to *modernity* and development policies that (…) tended to neglect local and environmental aspect' (Bonin 2008). Nevertheless, they have contributed to building the Alpine image of the valleys themselves, to shape the local landscape as it is perceived nowadays.

The intensive development of hydropower in the mountains of Europe came to an end in the 1960s, but since the late 1990s, renewed interest has resulted in a rapid new hydroelectric development, based on the construction of small plants supported by public policies in favour of renewable energy. Although these plants are normally less 'visible' and more dispersed throughout the territory, they are at the centre of several environmental and social conflicts today (CIPRA 2005; Alpine Convention 2011).

In this paper we propose to observe this conflictive development in a mountain area in the north-east of Italy. Our starting point is 'landscape of energy', a concept that is currently establishing itself in the literature as a tool for exploring the relationship between energy and landscape (Nadaï and van der Horst 2010; Ghosn 2010). Nadaï and van der Horst in particular suggest a twofold approach to this question: on the one hand, landscape can be interpreted through energy (pursuing an energy-driven interpretation of the landscape), and on the other, energy can be interpreted through landscape (so enabling energy development to become more landscape sensitive). According to these authors, if energy policy was viewed through a landscape perspective, it would have to take into account the time dimension. It would also have to consider its effects on civil society and encourage its participation in the process, so producing a landscape-sensitive energy policy that would be more efficient and effective. This is very important in our case because behind landscape, there is a world of meanings and values that drive decisions and changes and are at the core of landscape conflicts.

We propose then to observe hydropower development 'through landscape', i.e. using the landscape as a tool for analysis and interpretation of the development itself and in particular in order to make the values behind energy-related landscape change emerge. We propose to link what can be seen with what cannot, to connect what landscape can directly show us with what it hints at indirectly (Gambi 1973). How does the conflictive development of hydropower appear from a landscape perspective? Can landscape be considered not only as something to be defended from energy infrastructures (Soini et al. 2011) but also as an effective tool to enable us to investigate and understand the conflict better? This paper tries to answer these questions through a case study of the Piave river basin (Veneto region), where hydropower potential was widely exploited during the twentieth century and a new wave of small-scale hydropower development is currently taking place.[1]

9.1.2 Landscape as a Mediator

As is well known, landscape is a concept with a multitude of meanings. Its main peculiarity lies in the fact that it belongs to the spheres of both reality and representation. It consists both of objects and of ideas about these objects (Farinelli 1991).

[1]This paper is a first product of the Italian research group participating to the research project 'Ressources paysagères et ressources énergétiques dans les montagnes sud-européennes. Histoire, comparaison, experimentation', financed by the French government in 2012, within the research programme IMR (Ignis Mutat Res). This paper results from the common work of the authors. Nevertheless, Viviana Ferrario wrote Sects. 9.1.1, 9.2 and 9.3; Benedetta Castiglioni wrote Sect. 9.1.2. The authors together wrote Sect. 9.4.

The European Landscape Convention states the same, defining landscape as 'an area, as perceived by people'. This double dimension leads us to consider landscape as an intermediary between people and space or, in other words, as the interface between doing (as referred to objects) and seeing what has been done (as referred to meanings and values) (Turri 1998).

When analysing the immaterial aspect of landscape, it is important to bear in mind that through perceptions and processes, people assign a wide range of meanings and values to the different elements of landscape and/or to the landscape as a whole. Meanings and values belong to different categories, some of which are linked more to the material functions performed by the various elements of landscape (e.g. economic or ecological functions), while others relate to aesthetics, culture and symbols (e.g. beautiful or ugly from a visual point of view, local identity and so on). Through all its meanings and values, the landscape is an expression of the territorial project underlying the visual forms, which is guiding the current changes. Of course, the different stakeholders involved in a territorial project have different perceptions and assigned meanings and values to the landscape in different ways.

Differences in assigning meanings and values also arise due to 'landscape models' (Cadiou and Luginbühl 1995; Luginbühl 2012) acting at a cognitive level, both through widely shared cultural references and local community references. These models for instance drive our idea of beauty. Personal attitudes towards landscape also influence the assigned values. Finally, we should not forget that interests, roles, models and attitudes are not completely independent of one another. So, when looking together at the same landscape or when dealing with the same landscape transformation, different people view it through very different 'lenses', and these differences lie at the heart of possible landscape conflicts.

From this perspective, the plurality of approaches, meanings and values assigned to a specific landscape can highlight the many different facets of local territorial processes, in order to better understand and manage their complexity (Guisepelli et al. 2013). Landscape thus becomes a tool that serves many objectives, both in the analysis process and in the management and governance processes (Luginbühl 2004; Derioz 2008; Ferrario 2011; Guisepelli et al. 2013). As Derioz (2008) proposes, landscape as a tool helps us first with *initiating*: it allows us to formulate questions and hypotheses, and it facilitates 'freedom of speech', mobilising stakeholders. It also *indicates* the possible direction of change, it allows us to compare different points of view, and finally, it *integrates* various sector-based approaches, questions and points of view.

By observing the physical landscape, the stories, the norms and the policies, we can connect visible landscape with underlying meanings and values and connect landscape change with dynamics that are not directly visible involving stakeholders and their interests. By viewing energy 'through landscape', as we propose in this paper, we can uncover the values hidden behind actions, behaviours, debates and their outcomes and try to elucidate the stakeholders' reasons, strategies, values and disvalues.

9.2 Hydroelectric Landscapes in the Piave River Basin

9.2.1 The Study Area

Our case study is focused on the northern hydrographical basin of the Piave river in the Veneto region in north-eastern Italy. The Piave river basin extends from the Dolomites to the Adriatic Sea, across the Alpine and prealpine mountain areas, where the hydroelectric potential of the main river and its largest tributaries has been exploited since the end of the nineteenth century.

The Piave is today one of the most exploited rivers in Europe: over 80 % of its water flows outside its natural river bed (Franzin 2006). The river basin hosts one of the largest hydropower systems in Italy, with 12 large artificial lakes created by dams, with a total water capacity of 156 million cubic metres and with 25 hydropower plants which together produce an average annual energy of about 2,200 GWh (ENEL 1991; ARPAV 2012). Electricity is collected and transported thanks to a high-voltage power-transmission line (220 KV) that connects the Veneto plain with Austria.

Sadly, the Piave hydroelectric system is also well known for the Vajont tragedy (1963), when an enormous landslide slipped down into an artificial lake, creating a huge wave that jumped over the dam and swept away Longarone and other villages close by, killing 2,000 people in a few seconds. This disaster (predictable and avoidable – according to the final judgement) brought an end to hydroelectric exploitation in the Piave river basin in the second half of the twentieth century.

In the 2000s, new European policies in favour of renewable energy pushed for further hydropower development, revealing various breaks with past approaches. A diachronic review of this question shows how actors, location and the size of plants, i.e. their relationship with the context and the landscape they build, changed over time (Fig. 9.1).

9.2.2 Hydropower Development in the Piave River Basin, from External to Local Exploitation

In the twentieth century, in the Piave basin, several huge, top-down, hydropower plants were built by a small number of stakeholders from outside the Alpine region. The SADE (Società Adriatica di Elettricità), for example, exploited this territory to produce energy for the growing industrial zone of Porto Marghera, near Venice (Reberschak 2008). Development started in the prealpine area in the 1920s (with the damming of the Santa Croce natural lake and the installation of connected hydropower plants) and moved up towards the inner basin, the high Piave, in the 1930s, when SADE purchased other smaller local electric companies and their plants.

In the first part of the twentieth century, the link between tourism and dams in the Alps was generally strong. In the Piave basin, this was perhaps less strong, except

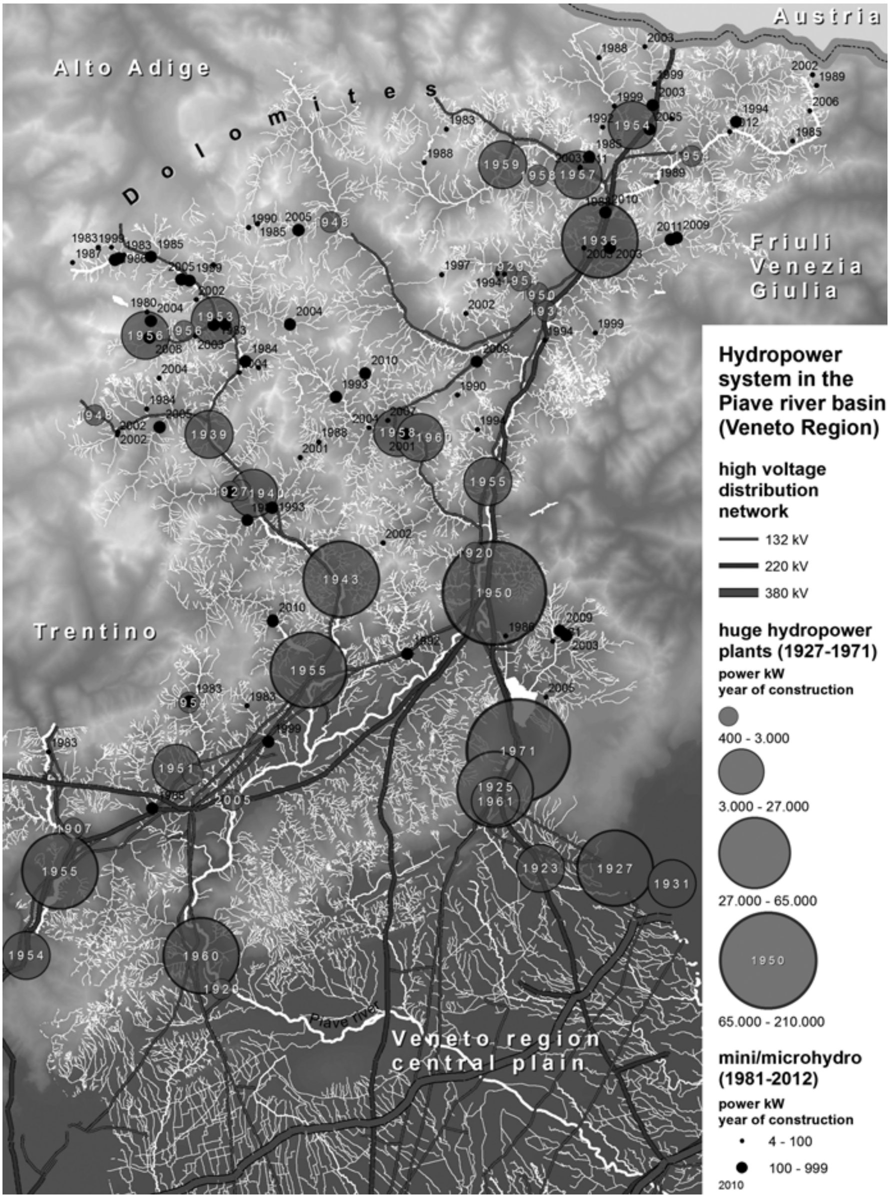

Fig. 9.1 The large hydropower plant system currently operating in the Piave river basin (*left*) and the recent small hydropower development (*right*). Electric power installed in the two systems has different magnitudes (from the data-base built up during the research Ressources paysagères et ressources énergétiques dans les montagnes sud-européennes. Histoire, comparaison, experimentation)

for the Santa Caterina artificial lake. Built by the private company Società Forze Idrauliche Alto Cadore in 1929–1932 and then purchased by the SADE, this seems to be the only dam in the Piave basin not only conceived as a hydropower plant but also integrated within a wider territorial project that included the development of the Auronzo valley for tourism, which was growing fast at the time. The architectural and landscaping efforts to beautify the dam bear witness to this. The plant at Santa Caterina lake is the only one in the Piave basin with an exploitation contract in which the level of the lake has to be maintained for tourism reasons, even at the cost of sacrificing electricity production.

After the Second World War, in the 1950s, the SADE company proposed a huge development project on the whole mountain part of the Piave basin. This process led to conflict with people living near the plants (e.g. in the case of the Pieve di Cadore artificial lake, where a number of houses and industrial settlements were sacrificed).

This huge project centred on the Vajont reservoir. The Vajont reservoir should have been the place to stock all the water extracted from the Piave and already turbined through other plants: a seasonal reservoir to feed the power house of Soverzene, the most important in the whole system. Extreme negligence when it came to studying the site led the company to underestimate the risk of a landslide which, as mentioned above, crashed into the lake in 1963, when the plant was in the process of being acquired by ENEL, the new national electric company created to perform the nationalisation of the electricity system. Due to this disaster, all activities at the Vajont reservoir ceased.

Although they were not part of an explicit territorial development project, artificial lakes and hydropower plants shaped the landscape of these valleys. This was especially true in the case of the Santa Caterina lake, where a new explicit tourism/energy landscape was formed, apparently without any problems of acceptance. On the contrary at the artificial lake of Pieve di Cadore, where the tourist use was only sustained by the local community and was considered largely secondary by the SADE, the disconnection from the territory still results today in persistent conflicts.

In fact, as in other parts of Europe, current conflicts in the Piave basin are mostly related with water management (Frolova 2010): at certain times of the year, the artificial lake of Pieve di Cadore is nearly emptied, because of the huge demands for water for hydroelectric and agricultural purposes (Rusconi 2000) – both coming from the Veneto plain, not from the surrounding local area. Locals consider the draining of the lake a devaluation of the landscape (negative for tourism), and a few years ago, this led to a controversy between local and regional administrations (Fig. 9.2).

The same thing happens in the Santa Croce lake, which is widely used for windsurfing and other water sports. Control of the water level in reservoirs is therefore a typical cause of hydropower conflicts in the whole Piave basin.

Fig. 9.2 Contemporary landscape conflicts: the artificial lake of Pieve di Cadore empty in spring 2012

More recently, the greatest controversy among scientists, policymakers, activists and citizens has revolved around the rapid and intense development of small-scale renewable energy hydropower plants on minor rivers.[2]

With the Directive 2001/77/EC, the European Union promoted electricity production from renewable energy sources. In Italy, that Directive was transposed into national law with D.Lgs 387/2003, with the objective, among others, of 'encouraging the development of micro-generation plants producing electricity from renewable sources, particularly in agriculture and in mountain areas' (art. 1).[3]

Since 2003, small hydropower plants began to be developed in the Veneto region, thanks also to the so-called certificati verdi (green certificates), which attracted private and public investors. As a renewable energy, at first glance, the development of small hydropower may seem very 'sustainable', due to the small scale of the plants and their scattered distribution all over the territory. In reality their impact is far from negligible from an environmental point of view, since they can have a serious impact on natural habitats and landscapes throughout the secondary hydrographic

[2] Experts usually distinguish between large and small hydropower plants. Although there is no international consensus on the definition of small-scale hydropower, a total capacity of up to 10 MW is becoming generally accepted. Small-scale hydropower can be further subdivided into mini hydro (usually defined as <500 kW), micro hydro (<100 kW) and pico hydro (<5 kW) (http://www.small-hydro.com; IPCC 2011). The Italian Authority for Electricity and Gas distinguishes between plants producing more or less than 3,000 kW (3 MW) when setting energy prices (APER-ADICONS 2003).

[3] The basis for a European policy on renewable energies was settled in 1996 with the liberalisation of the internal market in electricity (Directive 96/92/EC). In Italy the D.Lgs 79/1999 opened up the market to private producers. Complete liberalisation was achieved in 2007.

network (Copeman 1997; CIPRA 2005; Alpine Convention 2011).[4] By taking away water over long sections of rivers and streams, the small hydropower plants alter natural habitats in secondary valleys often of high natural value.[5]

On the other hand, the development of micro-hydropower can also be seen as a very positive attempt by local mountain communities to become energetically and financially self-sufficient, as the money coming from exploitation concessions can substitute the rapidly decreasing funds provided by the national government. Several municipalities have become promoters of new plants, locally called 'centralina',[6] or invited private investors to bid for concessions. In a short period of time, small-scale hydropower has expanded very fast, superimposing a new layer on top of the large hydropower landscape of the twentieth century.

9.2.3 Small-Scale Hydropower and Landscape in Recent Regional Policies

The regional administration plays an important part in this process. It authorises new plants and establishes rules and policies, both in terms of energy production/consumption and in terms of landscape quality. Nevertheless, regional policies reveal scant awareness of the relationship between landscape change and energy development.

The Regional Landscape Plan In 2009, a new territorial plan was adopted by the regional administration. In the Veneto region, this plan also includes a landscape planning scheme. The plan contains a Landscape Atlas describing local landscapes, their transformations and trends. It also sets out a number of 'landscape objectives' as suggested by the European Landscape Convention. These objectives include renewable energies, but nothing is said about small-scale hydropower plants. The 2013 review of this document does not mention this renewable source of energy either.

[4] Awareness of the problematic nature of small-scale hydropower development in mountain areas is increasing, not only in scientific circles but also amongst the general public. Here are some headlines from Italian newspapers from different parts of the Alps in recent months on the subject: 'Stop a nuove centraline idroelettriche in Val d'Aosta' (Stop to new small hydropower plant in Aosta valley), *La Stampa*, 8 giugno 2012; 'In marcia contro la centralina per difendere la Valle del Mis' (on the march against the small hydropower to defend the Mis valley), *Corriere delle Alpi*, 4 luglio 2012; 'Giù le mani dal Trebbia. Folla a Piacenza contro la centralina a San Salvatore' (Hands off the Trebbia river. Crowd in Piacenza against the small hydropower plant in San Salvatore), *Liberta.it*, 24 gennaio 2013; and 'Un sit-in contro le centraline in Valcamonica' (a sit-in against small hydropower plants in the Valcamonica valley), *Giornale di Brescia*, 27 febbraio 2013.

[5] The 'DMV, deflusso minimo vitale', is the minimum amount of water that should remain in the river beyond a hydroelectric plant, considered necessary to maintain life in the river. It was introduced by the Law 183/1989 and must be quantified at a regional level. In the Veneto region, the DMV is calculated by the Piano di Tutela delle Acque (Water Preservation Plan), adopted in 2009.

[6] *Centralina* is the Italian word commonly used when referring to small hydropower plants. It is the diminutive of 'centrale idroelettrica', the Italian expression for 'hydropower plant'.

'Unsuitable Areas' The fact that there are no references to hydropower does not mean that renewable energies are not considered a landscape problem by the Region. In 2012, the administration introduced some specific rules relating to the identification of the so-called 'unsuitable' areas for the installation of renewable energy production sites. This is an evident signal of an increasing awareness of the environmental and social impacts mentioned above. Nevertheless, the only sites declared by the Region as 'unsuitable areas' were those that were already protected (parks, protected areas, Natura 2000 areas, etc.): this seems to be a way of avoiding, at least temporarily, the issue of integrating renewable energy policies into the territorial project.

The Regional Energy Plan (SEA – Preliminary Report) In 2012, the Veneto region adopted the new Regional Energy Plan to reduce consumption and to increase production of renewable energies towards the Horizon 2020 objectives. In the SEA preliminary report three possible impacts of small-scale hydropower plants are identified: landscape impact, acoustic impact and biological impact. According to this document, landscape impact can be avoided or mitigated by 'masking components of the power-plants with vegetation, or using colours already present in the landscape'. It is clear that the document is solely referring to the 'visual' aspect of landscape and to the purely aesthetic values associated with its visual appearance. This approach is confirmed in the approved documents (2014).

9.3 Reading Micro-hydropower Through Landscape

So far, small-scale hydropower has been mainly studied from the perspective of its environmental impact (Copeman 1997) and of the 'contested discourses, divergent practices and differing policy perspectives' arising within the social conflicts it generates (Slee et al. 2011). In both cases landscape remains in the background, in the first case as an object to be protected and in the second as one of several discourses mobilised by certain stakeholders (in particular by the 'protectionists', according to Slee et al. 2011).

However, considering energy production as a component of the collective landscape construction process can help us understand these processes better. To verify this hypothesis, we analysed two of several new small hydropower plants in the Piave basin. Analysing hydropower-produced landscapes – both the physical landscapes and the ideas behind them – allowed us to raise some questions (*initiating*), to *indicate* some bad and/or good practices and to propose the *integration* of the various approaches.

The two cases we are going to present are to some extent opposites. The first, the 'centralina di Vigo', was developed by the municipality of Vigo di Cadore in 2005 and is now in use. The second, the 'centralina del Mis', was developed by a private company on land inside the Dolomiti Bellunesi National Park in 2008, but its construction was definitively stopped in 2012 after a long legal battle brought by environmental associations.

We based our analysis on three kinds of sources: informal interviews with stakeholders, on-line documents (press, associations, promoters and municipalities' websites) and visits to sites.

9.3.1 The 'Centralina di Vigo'

This small hydropower plant is situated along the road between Vigo di Cadore and Lorenzago. It is far away from the villages but very near to an old abandoned mill on the Piova torrent, a tributary of the Piave river, in the eastern part of the Cadore valley. It is a 'flowing water' plant, with an output of 1,040 kW and a potential production of 5,800,000 Kwh/year. It pumps a maximum of 850 l of water a second from the Piova. The drop is 195.47 m tall, and water from the Piova is transported over about 3 km along a pipe with a diameter of 800 mm. It is connected to the ENEL electricity transportation network. Electricity production will receive incentives in the form of green certificates until 2017. According to the municipality of Vigo di Cadore (Comune di Vigo 2010), two projects to build a power plant on the same site were proposed back in 1925 and 1980, but they came to nothing due to a lack of capital. Finally, in 2005, a plan was proposed in which the plant was to be financed 70 % by the Town Council and 30 % by the private company that today manages the plant. The private company keeps 30 % of the profits, while the remainder goes to the Town Council.

According to the local authorities, the plant has been widely accepted by local people (Comune di Vigo 2010) firstly because other hydroelectric projects had been developed in this area in the past (so people were already prepared for this project, 'used to' the idea) and secondly because of the *evident* economic benefits that can be quantified in about 500,000 euros per year (Comune di Vigo 2011). The 'centralina di Vigo' appears to be an ideal case, as the municipality presented its project to the PIMBY competition in 2010.[7]

What landscape has been created by this 'ideal' small hydropower plant? On site, one can observe (Fig. 9.3):

- an evident effort to hide/mask the plant (the main building is underground, with a green roof; the concrete wall is covered by a natural stone layer). The objective is however only partly achieved;
- an indifference towards the context. For example, the new plant shares its location on the River Piova with an ancient mill, now abandoned and in bad condition. A landscape-sensitive approach should have considered the possibility of

[7] PIMBY (please in my backyard) is a neologism obviously modelled on NIMBY (not in my backyard). It is also the name of a private association that presents an annual award to public administrations 'who build new infrastructures combining respect for the rules with citizen participation' (www.pimby.it).

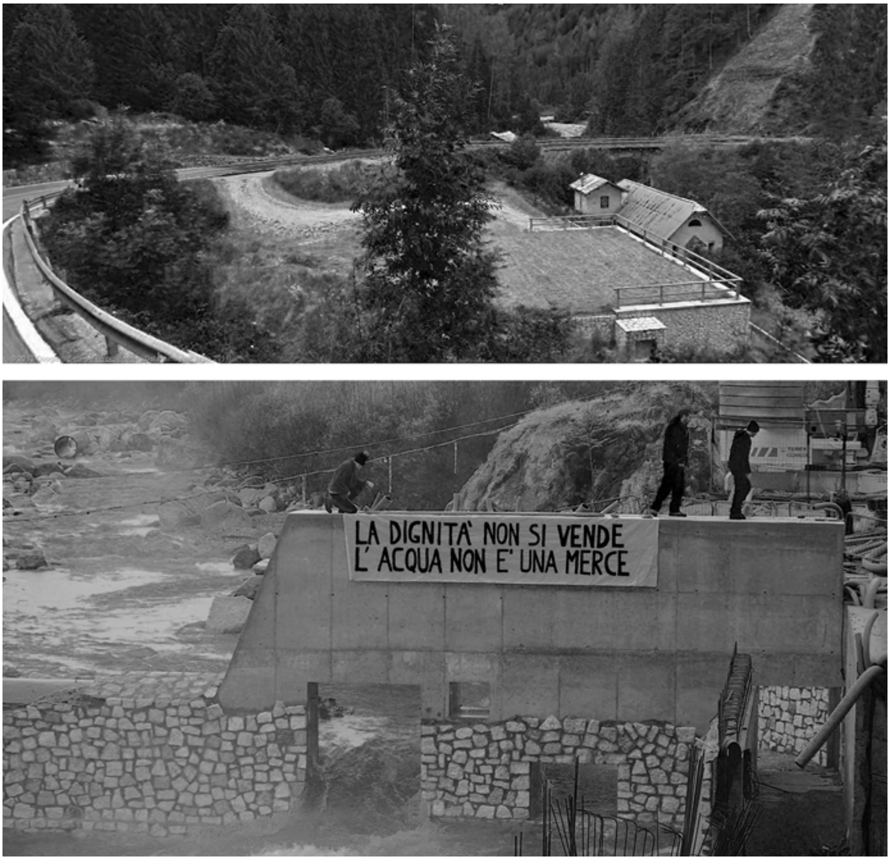

Fig. 9.3 The 'centralina di Vigo' with its green flat roof and the ancient mill (*above*); the 'centralina del Mis' building site used as a stage for protests ('dignity is not for sale/water is not a merchandise') (*below*)

renovating the old building as part of the energy development project, given that it is located in the same place and uses the same resource, the water of the River Piova;

- an indifference towards the space around the plant, completely transformed to make it accessible to heavy vehicles, but with no other treatment of any kind;
- if we raise our glances to take in the entire valley, we realise that the project does not build any relationships with any other local systems such as human settlements or the tourist network or the natural landscape around. There are only strictly functional connections to the road and to the electricity grid;

- finally, the lack of water in the River Piova downstream has changed the riparian micro-landscape. In 2012, the association 'Acqua Bene Comune' (see note 9) compiled a dossier comparing pictures of the rivers affected by the plants before and after the downstream outlet. They too *used* the landscape to analyse the situation and to protest about it.

What values lie beneath these landscape forms? Surely production is a value in itself. The only kind of 'public opposition' was in the form of requests for more transparency in the financial administration of the plant. Such requests arose as a result of a constant fall in public revenue from the plant. This was probably due to a fall in production in recent years, about which various stakeholders complained in March 2012.[8] Global climate change is one of the possible reasons, as the drought of the period 2011–2013 seems to indicate.

Although the functional and financial values were given priority, some attention was also given to the cultural and natural values that had to be preserved. However, this came in the form of 'hiding' or 'masking' rather than as part of an 'integration' strategy, as shown by the example of the mill. Moreover, the doubt arises as to whether the decision to hide the small hydropower plant was taken because it was considered ugly from an aesthetic point of view or because such plants are popularly associated with environmental damage and therefore better hidden from public view.

Finally, our analysis clearly shows that connecting energy production with other local activities and with the territory is not considered as a value. The local development sought with the small hydropower plants is far from being territorially integrated. The municipality sacrifices part of the environmental value of its territory to fill the financial gap caused by the drop in national contributions to local government funds. In this way the municipality could be said to be exploiting its own territory.

9.3.2 The 'Centralina del Mis'

In 2008, a private company asked for a permit to build a small hydropower plant in the Mis valley, in the municipality of Gosaldo, within the Dolomiti Bellunesi National Park (UNESCO World Heritage site since 2009). The proposed plant had a nominal power of 1,081 KW and would divert a maximum of 2,700 l/s water from the Mis river, with a drop of 72 m, along a pipe measuring 1,530 m in length and 1,150 mm in diameter. The energy produced was to be sold entirely to ENEL (BURV 2009).

[8] A visit to the plant together with an interview with the former Mayor of Vigo who commissioned the plant in 2006 took place in spring 2012.

Although the regulations in the Park's environmental plan prohibit using rivers for industrial use, all the authorities involved gave their consent (the Park, the Ministry of Cultural Heritage, the Regional Administration, the Municipalities, etc.). On 27 November 2008, in fact, the board of directors of the Dolomiti Bellunesi National Park ruled in favour of the plant on the basis of a regulation in the Park Plan which allowed them to authorise 'modest water diversions, to be reserved exclusively for activities the Park Authority intends to promote, encourage, carry out or allocate for its own institutional purposes'. The authority justified its decision by arguing that a small hydropower plant was comparable to a 'traditional production activity', something that had always been permitted inside the protected territory. The World Wildlife Fund, the Italian Alpine Club (CAI) and some other local environmental associations[9] denounced the private company and the authorities who gave the project the go-ahead, claiming that the intangible natural values of the area confirmed by its protected status within a national park could not be sacrificed for private profit.

The building site opened in 2008. After a long trial, on 9 November 2012, the Court found in favour of the claimants. The construction was brought to a halt.[10] It remains to be seen if any measures will be taken to return the Mis valley to its original pristine state.

It is difficult to interpret the landscape produced by the 'centralina del Mis'. The first problem is that the project is unfinished, and what we have is a landscape in construction and ultimately a series of different stages of this process. In addition, the landscape was used by opponents of the project as a media stage, who promoted their cause by means of on-site happenings, large banners, photo galleries and videos showing the area, etc.[11] The dramatic landscape of protest has been superimposed on the landscape of the building site itself (a dramatic landscape of energy production) (Fig. 9.3).

If we look beyond this unplanned, provisional situation, a number of observations can be made:

- in this case too, the main visible buildings are covered by a layer of natural stone, 'thus recalling the rural architecture typical of the area'. The powerhouse is situated

[9] Since the early 2000s, various environmental associations have been fighting against the new hydropower plants in the rivers in the Piave basin. One of the most active was an environmental association for the defence of public rights to water, called 'Acqua Bene Comune' (water common good). This association seeks transparency in the approval procedures and demands a new shared strategy for the use of water in the whole Piave basin. It also organises public demonstrations against projects that are considered problematic and to raise awareness amongst the public and the different levels of government (see www.acuabenecomunebl.org).

[10] Now the private company has presented a claim for compensation for 16 million euros against the authorities who granted them the permits.

[11] Although the building site was severely protected from external access, the Internet is full of images about the *centralina* del Mis building site. See, for example, www.bellunopiu.it (last access 27/02/2013) or http://www.youtube.com/watch?v=gHNKqlW1yy0 (last access 12/09/2013).

'under a rock wall so that it is scarcely visible…'. It 'will appear to be partially integrated into the slope, thanks to the green roof' (BURV 2009);
- the choice of the location, straddling the border of the protected area (the intake is outside the National Park, while the powerhouse is inside), is a sign of apparent disdain towards the natural values protected by the Park;
- despite the fact that the permit was given on the basis that the plant could be useful to the Park, there is no evidence, either in the documents or at the site, of any connection with park activities (Even if the Park's information point, which provides facilities for visitors, is about 1 km away from the site proposed for the 'centralina' along the same road. Moreover, the Titele Bridge, situated 50 m away from the intake plants, is one of the main access routes to the 'Cadini del Brenton', a famous geo-site).

First, we note that the 'landscaping' approach set out in the project coincided with that of the authorities involved and essentially involved a hiding/masking strategy, as can be seen in the application for landscape authorisation: 'The impact on the landscape will be mitigated mainly by disguising the buildings and the impact of the visible parts will be reduced by using building elements in continuity with the surroundings' (quoted in BURV 2009). All these grates somewhat when compared with the arguments are put forward by the aforementioned protest group.

The second observation refers to the absence of any attempt to integrate energy production into the context of the Park, either environmentally or socially, given that the Mis valley is the only one in which a road crosses the National Park and is one of the main access points to the Park itself.

A third observation refers to the attitude of the Gosaldo municipality: documents show how a small, mountain village with scarce financial resources can be in a weak position to withstand pressures from strong outsiders. Their position could perhaps be strengthened by ensuring a broader shared territorial strategy which includes landscape quality objectives agreed with other stakeholders and supported by the regional administration.

9.4 Conclusions and Remarks

Using the concept of 'landscape of energy' as a base, we explored the development of hydropower in the Piave river basin, finding that an interpretation of energy 'through landscape' not only is possible but also provides useful preparatory insights for a more aware, broader-based, landscape-sensitive development of renewable energies.

The analysis 'through landscape' of hydropower development in the Piave basin, in fact, throws up at least three conclusions that could be applied to every landscape-sensitive approach to energy planning:

1. *Hiding is not an effective strategy*. Modern-day small-scale hydropower plants are often hidden in lateral valleys and due to their size are often barely noticeable.

Additional efforts to mask the plants are frequently made, as if hiding the objects prevents possible conflicts arising from this form of local exploitation (by the local administration and local companies). But masking or hiding these plants does not solve the problems they create. On the contrary, even if the power plant buildings are masked, the environmental problems remain visible in the landscape, where the activists can take a picture of them or even use the plant as a stage for the protest. Some plants, in particular the old large ones, have a strong visual impact, and when they were built, they caused a huge transformation of their landscapes. Paradoxically, as the example of the Santa Caterina lake shows, the more visible the plant, the more likely it is to be considered within a larger territorial perspective.

2. *Energy plants must be integrated into the territorial project*. The case of Santa Caterina in Auronzo is emblematic: the plant involved the exploitation of local resources by strong stakeholders coming mainly from outside the mountain area; but it did not lead to explicit or diffused conflicts. In a way, the embellishment of the dam and the promenade around the lake served to mask all other impacts (ecological, social). This important landscape change helped to integrate the energy plants into the territorial project, which was largely tourism driven. By contrast, the two small hydropower plants on the Piova and the Mis demonstrate that this effort to integrate energy plants is today completely missing. Integration of energy development into the territorial project should mean encompassing the different values, meanings and interests involved in it, so preventing landscape conflicts.
3. *The underlying values need to be shared*; *landscape can help*. As the cases we analysed show, a 'landscape of energy' in the sense suggested by Nadaï and van der Horst (2010) does not yet exist here. The most diffuse approach towards landscape matters in this field is merely visual (see point 1), a narrow approach, unfortunately validated by the regional administration documents. On the contrary a systemic landscape approach would widen the perspective about hydropower plants, from the small scale of the single object to a larger scale that considers artefacts and networks, landscape changes and different perceptions, meanings and values. A 'systemic viewpoint' such as this one would help us to identify whether a particular hydropower production system is related to other systems or not. Such a viewpoint relates to the natural environment system, both at the scale of local stream dynamics and at the scale of global processes, including climate change. It helps us to see the connection with other production systems in the same area, such as forestry, agriculture, industry, tourism and culture, and finally, it enables us to visualise the value references of the different stakeholders.

Landscape functions as a 'prism that reflects the complexity of the concept of sustainability' and acts as an 'interface between sustainability principles and wishes of local development' (Guisepelli et al. 2013). It enables us to consider different issues and mediate between them (such as fairness, both in the case of outsider and local exploitation). This helps avoid 'yes/no' discussions, polarised positions that necessarily lead to conflicts, and instead allows us to think in terms of 'how', taking into account and respecting all the different values at stake.

References

Abbasi SA, Abbasi N (2000) The likely adverse environmental impacts of renewable energy sources. Appl Energy 65(1–4):121–144

Alpine Convention – Platform water management in the Alps (2011) Alpine signals focus 1. Common guidelines for the use of small hydropower in the alpine region. Permanent Secretariat of the Alpine Convention Bolzano. http://www.alpconv.org/en/publications/alpine/Documents/SHP_common_guidelines_en.pdf. Accessed 10 Mar 2013

APER-ADICONS (2003) Dossier Micro-Idroelettrico Progetto RES & RUE Dissemination. http://www.energie-rinnovabili.net/dossier-micro-idroelettrico-res-rue-dissemination. Accessed 10 Mar 2013

ARPAV (Agenzia Regionale per la Prevenzione e Protezione Ambientale del Veneto) (2012) Dipartimento Provinciale di Belluno – Servizio Sistemi Ambientali. L'energia in Veneto. Provincia di Belluno. http://www.arpa.veneto.it/arpav/chi-e-arpav/file-e-allegati/dap-Belluno/energia/Rapporto_energia_BL_2012.pdf. Accessed 10 Mar 2013

Bonin S (2008) Preface. Rev Géogr Alpine/J Alpine Res 96(1):10–28

BURV (2009) (Allegato A alla Dgr n. 4143 del 29 dicembre 2009) (regional authorization to the building of the hydropower plant 'centralina del Mis'). Bollettino Ufficiale della Regione del Veneto 12

Cadiou N, Luginbühl Y (1995) Modèles paysagers et représentations du paysage en Normandie-Maine. In: Voisenat C (éd) Paysage au pluriel. Pour une approche ethnologique des paysages. Éditions de la Maison de Sciences de l'Homme, Paris, pp 19–34

CIPRA (2005) Energia elettrica. Le Alpi sotto tensione, Cipra-Info 76:1–12

Comune di Vigo (2010) Candidatura premio PIMBY 2010 (Candidacy for PIMBY Award). http://www.pimby.it/dmdocuments/2010%20Comune%20di%20Vigo%20di%20Cadore.pdf. Accessed 10 Mar 2013

Comune di Vigo (2011) Bilancio di previsione per l'anno 2012

Copeman VA (1997) The impact of micro-hydropower on the aquatic environment. Water Environ J 11(6):431–435

Crook DS (2001) The historical impacts of hydroelectric power development on traditional mountain irrigation in the Valais Switzerland. Mt Res Dev 21(1):46–53

Davodeau H (2008) Des conflit revelateurs de la territroialisation du projet de paysage. In: Kirat T, Torre A (eds) Territoires des conflits. Analyses des mutations de l'occupation de l'espace. L'Harmattan, Paris, pp 49–61

Derioz P (2008) L'approche paysagère: un outil polyvalent au service de l'approche opérationnelle et interdisciplinaire des problématiques environnementales. 1éres Journées scientifiques ARPEnv – Université de Nîmes – 6 juin 2008. http://halshs.archives-ouvertes.fr/docs/00/36/36/25/PDF/Article_P_Derioz_-_ARPEnv-2008.pdf. Accessed 10 Mar 2013

ENEL – Ente Nazionale per l'Energia Elettrica (1991) Impianti del Piave: sistema nord-orientale. Venezia

Farinelli F (1991) L'arguzia del paesaggio. Casabella 575–576:10–12

Ferrario V (2011) Il paesaggio e il futuro del territorio (osservare e programmare). In: Paolinelli G (a cura) Habitare. Il paesaggio nei piani territoriali. Franco Angeli, Milano, pp 159–171

Ferrario V (2012) Lo spazio agrario nel progetto di territorio. Trasformazioni dei paesaggi rurali nella pianura e nella montagna veneta. Urban Press, Padova

Franzin R (2006) Il respiro delle acque. Racconti articoli saggi. Centro Civiltà dell'Acqua – Nuova Dimensione, Portogruaro

Frolova M (2010) Landscapes water policy and the evolution of discourses on hydropower in Spain. Landsc Res 35(2):235–257

Gambi L (1973) Critica ai concetti geografici di paesaggio umano. In: Gambi L Una Geografia per la storia, Einaudi, Torino

Ghosn R (2010) Energy as spatial project. In: Ghosn R (ed) Landscapes of energy, vol 2, New geographies. Harvard University Press, Cambridge, MA, pp 7–10

Girel J, Garguet-Duport B, Pautou G (1997) Landscape Structure and historical processes along diked European valleys. A case study of the Arc/Isère confluence (Savoie France). Environ Manage 21(6):891–907

Guisepelli E, Miéville-Ott V, Perron L, de Ros G, Peyrache-Gadeau V (2013) Paysage et développement durable: un mariage contre nature? In: Luginbühl Y, Terrasson D (dirs) Paysage et développement durable. Éditions Quae, Paris, pp 115–128

IPCC (2011) IPCC special report on renewable energy sources and climate change mitigation. Prepared by Working Group III of the intergovernmental panel on climate change. Cambridge University Press, Cambridge

Luginbühl Y (2004) Programme de recherche politiques publiques et paysages analyse evaluation comparaisons. Synthèse des résultats scientifiques. Cemagref. http://www.developpement-durable.gouv.fr/IMG/DGALN_synthese_PPP.pdf. Accessed 10 Mar 2013

Luginbühl Y (2012) La mise en scène du monde. Construction du paysage européen. CNRS Editions, Paris

Malesios C, Arabatzis G (2010) Small hydropower stations in Greece: the local people's attitudes in a mountainous prefecture. Renew Sustain Energy Rev 14:2492–2510

Murphy D (2012) Landscapes of energy. In: Butler T, Lerch D, Wuerthner G (eds) The energy reader. Overdevelopment and the delusion of endless growth. Foundation for Deep Ecology. Watershed Media, Healdsburg

Nadaï A, Van der Horst D (2010) Introduction. Landscapes of energies. Landsc Res 35(2):235–257

O'Neill J, Walsh M (2000) Landscape conflicts: preferences identities and rights. Landsc Ecol 15(3):281–289

Olwig KR, Mitchell D (2007) Justice power and the political landscape: from American space to the European landscape convention. Introduction to a special issue. Landsc Res 32(5):525–531

Reberschak M (eds) (2008) Il grande Vajont. Cierre edizioni, Sommacampagna

Romerio F (2008) Regional policy and hydroelectric resources. Rev Géogr Alpine/J Alpine Res 96(1):79–90

Rusconi A (2000) Il bilancio idrologico e l'uso delle acque. In: Bondesan et al Il Piave. Cierre edizioni, Sommacampagna

Slee B, Whitfield R, Whitfield S (2011) Discourses of power. The development of small-scale hydropower in North East Scotland. Rural Soc 21(1):54–64

Soini K, Pouta E, Salmiovirta M, Uusitalo M, Kivinen T (2011) Local residents' perceptions of energy landscape: the case of transmission lines. Land Use Policy 28:294–305

Turri E (1998) Il paesaggio come teatro. Dal territorio vissuto al territorio rappresentato. Marsilio, Venezia

Wolsink M (2007a) Wind power implementation: the nature of public attitudes: equity and fairness instead of backyard motives. Renew Sustain Energy Rev 11(6):1188–1207

Wolsink M (2007b) Planning of renewables schemes: deliberative and fair decision-making on landscape issues instead of reproachful accusations of non-cooperation. Energy Policy 35(5):2692–2704

Wüstenhagen R, Wolsink M, Bürer MJ (2007) Social acceptance of renewable energy innovation. An introduction to the concept. Energy Policy 35(5):2683–2691

Part IV
Renewable Energies and Protected Landscapes

Chapter 10
Wind Power and Environmental Policies

Ethnography in "Protected Landscapes"

Ana Isabel Afonso and Carlos Mendes

Abstract Wind farms in Portugal have spread enormously during the last decade and are transforming social and physical landscapes. The map of classified areas in the country shows a great overlap between main sites of potential wind development and protected areas. Starting from case studies in different regions where wind power has been recently developed, we approach issues of landscape management, protection, fruition, and how they are intertwining with energy policies. Through ethnographic lenses, our aim is to understand how global issues are perceived at local level, selecting as case studies projects involving protected areas in Portugal.

Keywords Wind power • Protected areas • Landscape and environmental conflicts • Local acceptance • Management of the commons in Portugal

10.1 Introduction

This chapter is based on previous research on the topic of wind power, landscape, and environmental policies – the main focus of an international collaborative project.[1] In this project, wind farms in France, Germany, and Portugal were taken as starting points from which to reflect on the systems of knowledge that frame local practices concerning landscape construction, fruition, and negotiation.

[1] 'Eoliennes et paysage: La politique éolienne entre politique de l'environnement et politique du paysage' research project in collaboration with the Centre International de Recherche sur l'Environnement et le Développement (CIRED), under the sponsorship of the Ministère de l'Écologie et du Developpement Durable (MEDD, France) – "Paysage et développement durable" Program (2006–2010).

A.I. Afonso (✉)
FCSH - CICS.NOVA, Universidade Nova de Lisboa, Av. Berna, 26 C,
1069-061 Lisbon, Portugal
e-mail: ai.afonso@fcsh.unl.pt

C. Mendes
Centro de Estudos Comparatistas (FLUL), Instituto Politécnico de Viana do Castelo,
Avenida do Atlântico, 4900-348 Viana do Castelo, Portugal
e-mail: cmendes@estg.ipvc.pt

M. Frolova et al. (eds.), *Renewable Energies and European Landscapes*,
DOI 10.1007/978-94-017-9843-3_10

The spread of wind power throughout the Portuguese territory since the beginning of the twenty-first century shows two important specificities in comparison with France and Germany. On the one hand, some wind power projects were built in protected areas, with only weak resistance of the local populations inhabiting in nature parks and even with some local groups claiming for greater development of wind power. On the other hand, the construction of wind farms in communal lands (the *baldios*) has contributed to empower the local populations and to renew long-standing antagonisms between rural inhabitants of protected areas and conservationist authorities regarding the management of the commons (*baldios*). In Portugal, the *baldios* (sing. *baldio*) are characterized by their nature of communal land, managed by a group of neighbors according to law and local custom. Some of the more frequent uses of these properties were, for example, collective cutting of firewood, irrigation, cattle raising, or shared community buildings (such as mills or ovens).

This article aims at approaching these issues through the analysis of three case studies in Portuguese-classified areas where significant controversies around wind power development recently emerged. A wind farm settled in communal lands in the Natural Park of Aire and Candeeiros Mountains has been contested by a local association, which considers that the incomes it brought to the local community do not compensate its negative impacts on the landscape and the environment.

In the Natura 2000 site of Arga Mountain (NW Portugal), three of the originally planned wind turbines were relocated, after strong local opposition due to its visual impact on a landscape charged with religious symbolism in the region.

Lastly, the recent public debates on a new planning scheme for the Natural Park of Montesinho (NE Portugal) were dominated by the controversy around the construction of wind farms in communal lands. Local populations argued against the environmentalists' and conservationists' viewpoint expressed by the governmental institution ICNF[2] and maintained that it was their own right to decide whether or not it should be allowed in the protected area.

We carried out ethnographic research in these wind farms and protected areas and proposed ourselves to follow the shifts in existing networks and customary practices, as well as to trace the activities of the main actors and the rise of new ones. In accordance with the actor network theory, we consider windmills as active parts and as agents in these networks (Latour 2005), which have the ability to bring forth new assemblies, as our case studies may illustrate. This "grassroots perspective" is focused primarily on the concrete techno-human networks that bring forth wind power.

Wind energy is a highly symbolic mode of production, and its specific history is revealed by a detailed analysis of the different discourse constellations that are

[2] At the time of our research, the Institute for Nature Conservation and Biodiversity (INCB) was the governing body that supervised protected areas in Portugal. From 2011 onwards, this organization became known as the Institute for the Conservation of Nature and Forest (ICNF). Henceforth, we will adopt the present denomination in this text.

associated with its emergence. Thus, we suggest situating the process of wind energy implementation in relation to the historical and societal discourses that enabled it. It is our assumption that the proliferation of wind power and other renewable energies is more than an economic or local phenomenon. Following Çalişkan and Callon (2009), the "process of economization" of wind power through which that energy is endowed with a qualification and an economic value cannot be understood without taking into account the social and cultural relations in which it is being embedded.

Ethnography of the case studies started by media survey and analysis – news published in the press, blogs, or other digital media. While surveying the news on the topic of renewable energy, we could acknowledge that the topic of landscape in Portugal seemed to be, with a few exceptions, a red herring or, perhaps, an invisible issue. This invisibility makes a paradoxical contrast with the unmistakable physical (but also social and economic) transformations brought about by the spread of wind power in the country, either in sparsely populated mountains or in enclaves along the urban centers near the coast.

From this still distanced approach based on media analysis, we felt that, in comparison to what was happening in other European countries, different conceptions of landscape, beyond the visible or contemplative, could be evidenced in the dynamics of the processes underlying the various transformations generated by the emergence of this new energy.

In the regular visits we made to the field, we interviewed key informants (unstructured and semi-directed interviews) and captured different perspectives: local citizens and technicians – with favorable and unfavorable opinions about wind energy in protected areas, local administrators (mayors and chairmen of parish councils), representatives of regional and national environmentalist associations, representatives of the Institute for the Conservation of Nature and Forest (ICNF), and finally, entrepreneurs from different companies with investments in the wind power industry. Key informants were selected following snowball strategy. We have also had informal conversations with local inhabitants from different backgrounds.

The initial surveys and the interviews conducted were complemented by documentary research. Particularly relevant materials were provided by ICNF. It included dossiers about licensing process of wind farms, as well as legislation concerning nature parks management. With this combination of methods, our goal was to capture the perspectives of different actors in the process of development of a wind farm that would allow us to consolidate our knowledge about the local impact of these changes.

The paper is organized around three main axes – we start with a panoramic view of the context, addressing the emergence and expansion of wind power in Portugal, as well as the discourses associated with it. Then we reflect on the processes that accompanied this expansion, sorting out relevant tensions and conflicts that occurred. In the last section, we approach the issue raised by the built-up of some wind farms in protected areas, through the presentation of our case studies.

10.2 Wind Power Policies in Portugal: A Brief Overview

Portugal is highly dependent on imported energy, mainly primary fossil sources. Currently, renewable energies are considered an important alternative source of energy and became a priority in the national energy policy agenda. National concern has also been fuelled by European directives and other international commitments within the Kyoto Protocol.

RES development in Portugal has been slow. Administrative barriers (especially the bureaucratic licensing process with the high number of entities involved) have hindered a greater development, especially for hydropower and solar technologies. Wind energy constitutes a notable exception within this framework. It has been growing at a high rate during the last decade and decisively contributed to fulfill its obligation with last Renewable Energy Directive (EUR-Lex 2009), i.e., producing circa 40 % of the total electricity consumed through RES.

In the footsteps of other European countries, Portugal promoted RES – especially wind energy – through the adoption of feed-in tariffs for renewable energies, direct subsidy payments, and tax incentives. Beginning in 2005, a tendering/concession process has also been established. In practice, subsidy payments and tax incentives have been both largely used for smaller-scale renewable energy applications, while feed-in tariffs and tendering schemes have been mainly used for larger-scale renewable projects. Nowadays, with the severe economic crisis that is affecting the country, some of these incentives are being reconsidered. This has slowed down the development of ongoing projects and almost stalled the application of new ones.

Looking back at the recent history, the first Portuguese wind farm was built in 1988, in Santa Maria, Azores. At this early stage (from the end of the 1980s until the end of the 1990s), cautious investments restricted to small wind farms predominated. The boom in terms of installed capacity and number of wind turbines started only in 2001, greatly due to the introduction of feed-in tariffs, differentiated by technology (wind, solar, hydro, or biomass). Moreover, legislation establishes that city councils will benefit from a 2.5 % share of income from all the wind farms located in their municipal territory.

During this expansionist period, we could follow the emergence of megaprojects with national impact. Installed by the end of 2008, the Alto Minho Wind Park, for instance, was strongly advertised by the government as "the biggest in Europe" (120 turbines and 240 MW of installed capacity) and became very emblematic of the alleged environmentally benign economic growth and technological development of the country. Recent statistics show that in 2012, Portugal has occupied the third position within EU15, having incorporated 42.7 % of RES in the total of electricity consumption (DGEG 2013).

Nevertheless, the current economic crisis barred this expansion and has profoundly affected future wind power investments. Only 19 MW has been licensed since 2010, which roughly corresponds to 5 wind turbines (DGEG 2013). The activity in the sector has been restricted to a few cases of repowering and has almost stagnated.

The majority of the licensed RES power capacity is situated in the north of the country, where a considerable number of wind farms were constructed, mainly because of the big hydro and grid access resource. It is also in the north of the country that the best areas of wind potential are concentrated.

As we can see in Fig. 10.1, there rises a strong overlap between areas of wind potential and protected areas, which constitutes an important issue that has been at the core of controversies around the sitting of wind farms throughout the country. In some cases, wind farms were even constructed in protected areas, which strongly motivated the focus of our research and reflections, presented in the following sections.

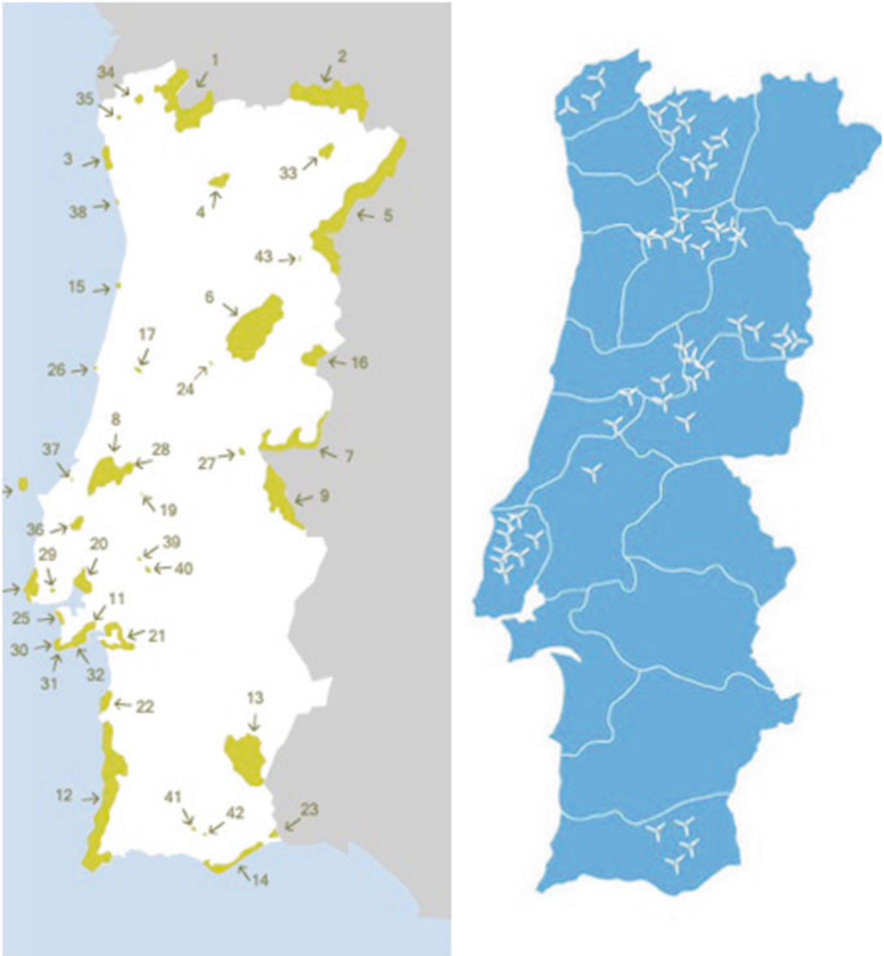

Fig. 10.1 Protected areas and wind farms in Portugal (Source: ICNF/ENEOP-Eólicas de Portugal)

10.3 Wind Power, Technological "Drive," and the Environment

Apart from its intrinsic economic interest, wind power has been seen as an opportunity to reimagine the collective identity of the country in terms of "modernity" as well as to argue its undisputed condition as a member of "Europe." The desire to harmonize the social expectations of modernization with increasing environmental sensibilities through the spread of a new (and benign, as it is presumed) mechanized landscape seems to prevail. Due to the lack of a broad public debate on the environmental, aesthetic, and social impacts of wind power, this perspective has been essentially unquestioned. In a way, it can be said that the expansion of renewable energy in Portugal is literally turning the remotest areas of the country into "laboratories of modernity (Stoler 1995)."

Even the construction of wind farms in protected areas has raised only some sporadic opposition from environmental groups, mainly through press releases distributed to the media. However, the so-called environmentalists (belonging to NGOs or working for ICNF) also seem unable to get support from civil society in their own spheres of action. In general, people living in protected areas resent the restricting rules regarding the construction of wind farms in national parks and tend to interpret them as illegitimate interference from external forces – particularly the preservationist authorities with their aspirations for modernization and economic development.

It is important to note that the creation of protected areas in Portugal is very recent, when compared to most countries in Europe. In practical terms, politicians decided to create protected areas in order to align with international agreements (Ramos et al. 2003). The adoption of preservationist policies in Portugal was not vindicated by civil society. Therefore, the history of interactions between local authorities and conservationists has been particularly contentious.

The perception that conservation restrictions are futile obstacles to modernization projects is relatively popularized in Portuguese society. This has especially been the case during the expansionist period of the 1990s, when construction in general and proliferation of motorways in particular took place under strong pressures on the protected areas.

In the north, the circumstance of the prevention of a motorway construction, allegedly because it would cross the territory of a threatened population of Cabrera's voles, is still fresh in the collective memory. It has attracted the interest of public opinion because of the sarcastic tone of the debate, ridicularizing the irrationality and blindness of top-down protectionist measures.

Thus, the prospect of new wind power structures in protected areas revives these controversies and suspicions, taking into account that a significant part of the Portuguese territory with wind power potential is located in protected areas, such as natural parks or Natura 2000 Network sites. It also reignites old tensions between local populations and central government representatives.

This ancient conflict cannot be understood as detached from the national process of landscape classification and from the constitution of heritage sites. The management of Portuguese-protected areas has ever been threatened by diverse real estate lobbies and local aspirations of "development." Confronted with EU Directive of RES quotas, environment policies and politicians face the dilemma of promoting the expansion of "clean" energy sources or blocking it, as it might have severe negative environmental impacts.

It was then interesting to follow the emergence of new regulations, restructuring efforts towards planning instruments (such as natural parks' planning schemes) or the battles to reinterpret the existing ones, underlining different lobbies interested in the regulation of their own interests (local citizens, wind power developers, ICNF officers, tourist enterprises, municipalities). In hindsight, the processes of public consultation (usually a pro forma, with insignificant expression) occurred with a rate of participation that had never been seen before. Different voices, ranging from local and regional administrators, to entrepreneurs, ICNF officials, or environmentalists from different NGO's, could be heard by spontaneous groups of inhabitants, giving visibility to different local interests, doubts, and expectancies towards future wind power projects in the country.

As far as we could acknowledge, wind power, even in the very embryonic stage of a remote hypothesis, had the strong capacity of promoting the dialogue, opening future channels of communication through which local populations could take part in the decision process that directly addresses and affects their everyday uses and practices related with landscape, the environment, and endogenous resources (Hess 2007).

In the course of our research, we were able to follow different regional debates and controversies. In some cases, local groups and authorities supported the new wind farm, as it was expected to bring economic benefits to the community; in other cases, they did not. Regional and national environmental associations generally opposed the construction of wind farms in natural parks. In addition to their fears of negative impacts on the "natural values" of the region, the environmental NGOs particularly feared that in this atmosphere of general acceptance of the expansion of wind power in the country, the areas subject to greater restrictions were being strategically target by wind power developers, so that they could no longer face opposition in allegedly less protected or valued natural areas.

With this respect, we have commented earlier (see Afonso and Mendes 2010) on a campaign sponsored by the Portuguese government consisting of a series of advertisements intended to promote the results of recent efforts of "modernization" and a country in tune with its age. We noted then the significant absence of images of wind turbines and solar panels in the advertisements echoing the growing weight of renewable energies in the Portuguese economy.

This campaign seemed to sum up recent efforts from national and local government authorities to transform both physical and symbolic landscapes of the country through the extensive adoption of renewable energies, notably wind power. Apparently, politicians found there a new ground to bridge the divides between "tradition" and "progress," "nature," and "culture."

Obviously, this expensive worldwide campaign was also meant to attract new investors and tourists to the country. Thus, although the extensive and fast adoption of renewable energies was apt to suggest the modernizing vein of the present Portuguese policies and therefore to obtain some interest from potential investors, a landscape full of wind turbines could keep tourists away from the country. This could particularly be the case of those from economically developed countries, who value environmental sensibilities, but may be disappointed by the dissemination of mechanical structures throughout the countryside. In order to mitigate the impacts of wind power on the tourism industry (we shall remind at this point that during our research, the large majority of wind power skeptics we met are developing local tourism projects), the political authorities struggled to "green" the decision of "spoiling" the "unspoiled" landscapes of the country with the arguments of globalization and climate change.

As a result of these ambiguities towards nature, conservation policies and the management of protected areas, a strong impetus for the restructuring of the existent official instruments of landscape management (such as the PO[3]), took place under strong political and economical pressures. In parallel, local traditional structures responsible for the management of the commons (mostly abandoned), in places considered with great potential for wind power, were suddenly revitalized.

While such processes were taking place, the first wind farms started to emerge in some protected areas. They illustrate different histories of acceptance, conflicts, or success, as we will explain, based on three case studies in protected areas, where wind farms have been or might be constructed. Such case studies allowed us to reflect upon relevant issues which emerged with the spread of wind farms in the country, focusing our study on the arena of negotiations over landscape uses and management, as well as on the articulation between environment and energy policies.

10.4 Wind Parks in Protected Areas

10.4.1 PNSAC: Global Concerns and Local Costs

The wind farm visible from the tiny village of Aldeia de Chãos was the first to be settled within the perimeter of the Natural Park of Aire and Candeeiros Mountains. Each of its 37 wind turbines is 90 m high and is rated at 3 MW capacity. Around the natural park, other wind farms have been installed during the last decade.

Local authorities in the region struggle for wind power, as it brings them opportunities to get extra incomes by agreeing with the companies on a share of the profits they obtain from the energy produced locally. The authorities celebrate a new wind farm, not only as an unquestionable achievement for the development of a local community but also as a non-negligible effort in order to contribute to national environmental objectives.

Anthropologists dealing with the theme of wind power dissemination in Portugal may have the opportunity to study emergent possibilities of political appropriation of environmental discourses and the production of new senses of "locality" (Appadurai 1996). It is now increasingly arguable that local decisions in a

[3] PO (Plano de Ordenamento) is the official planning scheme that regulates the national park.

"remote area" may have a valuable impact on the national level or even on the whole humanity.

Wind power seems to be also reshaping political power and relationships locally. Recently, in Alqueidão da Serra, after the *Junta de Freguesia* – the entity that governs the civil parish – had settled an agreement for the installation of a new wind farm in the vicinity of the protected area, the president of the junta offered two expressos to each of its inhabitants (a total of 1,600 expressos). "A toast to the future," he declared to a local newspaper. By "future" he was not only meaning "development" for the parish, but also invoking a new order in the relationship between the junta and the town council of Porto de Mós that was deliberately put aside of the negotiations – usually tripartite – with the wind power developer.

When we visited the wind farm in Candeeiros guided by a Park ranger, he suggested to us amusedly that we should take a picture of an official sign and a nearby wind turbine in the same frame. The sign – sponsored by the wind energy enterprise and composed by ICNF – adverts the potentially unaware visitors that they "are in a protected area." We take this ironical disposition, following the anthropologist James Fernandez, as a "perception of incongruity" (Fernandez 1986) that deserves to be noted (Fig. 10.2).

Fig. 10.2 Wind turbine in the Natural Park of Aire and Candeeiros Mountains (Photo: Ana Isabel Afonso)

Incongruity reflected by the "care towards nature" that the quote in the sign suggests, and the "thread towards nature" represented by the proximity of the turbine with the sign. The sign also asked the visitors not to pick plants or to capture animals and to contribute to the protection of species and habitats.

The issue in this incongruity is not as much the visual impact of the turbine, as background for the photo, but the "damage" it has caused for being there, reinforced by the incongruent quotes it exhibits (although the visitors are asked "not to take animals or plants," how many animals have been affected and plants been picked during the installation stage?).

So, in itself, the sign denounces another "impact," an ecological one, as an increasing number of visitors started to threaten the fauna and the flora. As our informant told us, in a mountain ridge rarely visited before, it was possible to see around 600 visitors in the weeks next to the settlement of the wind farm, surely attracted by the novelty of the "technological sublime" (Marx 2000) that some tourism companies were already highlighting in their pedestrian trail packs.

In other words, what the park ranger wanted to underline using irony was the incongruity of environmental policies in relation with what they (pretend to) protect, suggesting, in addition, traces of corruption in the business that are being promoted.

Although visual or aesthetical "impacts" have been addressed by local informants and propagated in the media (press and blogs), such visual impacts tend to be quickly belittled by local officials as matters of personal taste, as if questions of taste were subjective and individual, not socially constructed.

We were only aware of a single episode of effective collective opposition to wind power in Portugal, argued fundamentally on the basis of scenic values, in the Arga Mountain – a Natura 2000 Network site in northwestern Portugal. The local pilgrimage commission has demanded successfully that the wind turbines in the region were not visible from the São João de Arga Monastery (see below).

Besides visual (eventual) negative impacts, other objections to the wind power settlement in the Candeeiros Mountain were the noises heard in the Aldeia de Chãos, the village nearest to the wind farm, and the windmills flicker effect. Divergent voices came from members of a local association, the Cooperativa Terra Chã, which was actively engaged in promoting "sustainable local development" projects, notably on the development of rural tourism (for instance, thematic trails inviting visitors to observe local people practicing traditional agriculture). Besides the potential damaging effects of the noises emitted by the wind turbines on the welfare of the Chãos inhabitants, the predictable negative consequences to leisure activities in the village were particularly underlined. It has been argued that urban visitors would not want to expose themselves in the countryside "to the same noise they are used to in the cities." In a way, wind power brought the "city" to the village (Williams 1973).

The dubious position of the municipality in the negotiations with the developer, which contributed to the construction of the wind farm in Candeeiros, was also put in question. On the one hand, the town council of Rio Maior is accused of usurping the management rights over the commons of Aldeia de Chãos. According to a member of the association, the commons were registered as properties under town council administration without the agreement of the assembly of neighbors. On the other hand, the *Junta de Freguesia* – to whom the assembly of neighbors had temporarily delegated the management of the commons – was blamed for complicity with the town council and accused of taking decisions without consulting the assembly of neighbors. Apart from the involvement of the different parts in the controversy, we must sort out that a key claim against the wind farm is based on the traditional rights of a local community to manage the communal lands.

Local populations do recognize the commons as collective property. They know every other neighbor that is allowed to make use of it according to customary uses and knew their former owners. On the other hand, the natural park introduced a new conception of "collective property," that is, the notion that local landscape and natural resources also belong to the "national community" and even – through the Natura 2000 Network – to the "Europeans." This obviously requires some disposition to accept that complete strangers may legitimately have a word on the management of their own local resources. But on the contrary, our informants inhabiting protected areas tend to resent the measures imposed by the conservationist authorities as particularly intrusive ones.

Complaining as much as before, when they were being deprived from the scarce resources they had in hand (mainly the extraction of stone from the quarries), some inhabitants of Aldeia de Chãos experience the same feeling of bearing all the costs of modernity and global concerns related with environment protection, without gaining any of its benefits – "if at least we were offered a discount in the electricity bill…," commented one of our informants. In so doing, he suggested the relevance of the counterparts in the negotiation of conservationist measures that can only succeed with the direct involvement of local populations (through the consultancy of the assembly of neighbors) and not against them, using the interstices of law to implement top-down measures of landscape management.

10.4.2 Serra d'Arga, Not from the Monastery

In the Arga wind farm, 12 turbines with 36 MW installed capacity are placed within the perimeter of an environmentally "sensitive area" already declared a classified site under the European Natura 2000 Network (PTCON0039-Serra de Arga).

Besides its preservation status, the Arga Mountain is also an emblematic religious place in Minho. Vernacularly, Arga is frequently referred to as the "Holy Mountain." Also, hermits used to inhabit the mountain in the past. Monasteries and chapels still remain all over the mountain. In a sense, it is almost as if the mountain retained the sacred attributes of the religious men that inhabited there, and the remaining buildings where they lived kept sanctifying the whole place since then (cf. Miller 1998).

Inaugurated in 2006, the Arga wind farm is the result of the ambitious efforts sponsored by a partnership of several local municipalities of the Alto Minho region to increase the wind power installed capacity in the area with the addition of 310 MW more by the construction of 16 new wind farms (also known altogether as the Alto Minho wind farm). At that time, the wind farm was expected to produce around 57 GWh yearly.

A Declaration of Environmental Impact (DIA) was emitted in March 2003. Although generally favorable to the construction of the Arga wind farm, the DIA imposed some constraints. The most relevant constraint consisted in the relocation of three wind turbines. Otherwise, if the original plan persisted unchanged, these turbines would be visible from the São João d'Arga Monastery. The DIA determined that not even the end of the wind turbines' blades could be observable from the monastery.

Dating from the twelfth century, the sanctuary's chapel is the typical rustic and late Romanesque architecture that one can find in Minho (Oliveira 1995). Since it is considered to be "one of the most important medieval testimonies in the region," the classification of this small monastery as a national monument was proposed in 1998 by the Portuguese Institute for Architectural Heritage (IPPAR) that took part in the environmental impact assessment commission as a member. Consequently, it was mainly the IPPAR that insisted in the need of conditioning the emission of a permit to the relocation of those wind turbines.

Having in mind its profile of a classified site under the Natura 2000 Network, the imposed constraints not only restricted what should not be seen from where, but also the licensing entities introduced specific requirements on building works, interdicting construction one hour after sunrise and another hour before sunset, in order to minimize potential negative environmental impacts and limit perturbations in wildlife during the works.

Another constraint imposed by the licensing entities was the installation of gates in the park, so that cars could not enter into the site. The authorities were surely aware of previous experiences in Portuguese wind farms – as in the Candeeiros Mountain, for instance (see above, Afonso and Mendes 2010) – where people, attracted by a mixture of nature, gigantism, and technology, got used to visiting wind farms, intensifying the circulation of vehicles in environmentally sensible areas as the Arga Mountain. According to the manager of Empreendimentos Eólicos do Vale do Minho, José Miguel Oliveira, "nowadays, everyone wants to visit the wind farm and we had to place gates for the first time in our parks." Albeit that, visitors are allowed – and even encouraged – to visit the wind farm on their foot. The promoters are planning "to build an information center and pedestrian trails" around the place.

The main section of the wind farm is located on a plateau – the Chã Grande – that the surrealist poet António Pedro once described as a "quiet atmosphere of sensitive ruins." This is a very evocative place, with its religious temples and pastoral landscape, full of vestiges of cultural and geological past, a place full of ruins.

In the environmental impact assessment (EIA) submitted by the promoters, the "presence of the wind turbines" – all twelve – was already invoked as a negative result of the construction of a wind farm. Nevertheless, the EIA also mentioned that this impact over the landscape is "a subjective matter."

However, although the pilgrimage's committee opposed to the location of three wind turbines in the project, the installation of a wind farm in the Arga Mountain was fairly peaceful. *Vestas*, the manufacturers of the turbines, do not exaggerate when they claim that there is "strong local support" to wind power in the Arga Mountain. Once the problem of the impact on the sanctuary and the festive activities that take place there yearly is surpassed, the wind farm became generally consensual, as well as the perspective of future wind farms in the "Holy Mountain."

The Arga Mountain is sparsely populated. Only 300 persons inhabit an area of more than 3,000 ha. In addition to the unproductive nature of the vast majority of the mountain's lands and the peripheral condition of the area, the growing depopulation of Arga throughout the twentieth century is often regarded as the main cause of the present-day preservation of its natural and cultural heritages. Here, a mere half an hour away from a national district capital, Vestas' technicians found themselves "in the savage side of the world" – the expression they used to title a document defending the Arga wind farm as exemplary in terms of respect for local "natural values." In a poor mountain inhabited by much more semi-savage cattle than persons, smaller impacts were to be expected, notably social impacts. Truthfully, and contrarily to the Candeeiros wind farm, in Arga the remaining inhabitants do not claim to be affected by noise or shadows in consequence of the presence of the turbines. They only see the turbines, and this apparently does not constitute a problematic issue for them.

Nowadays, the wind farm revenues to the community from the rental of the commons sited in the civil parishes of Arga de Cima and Arga de Baixo are highlighted locally as a rare opportunity to guarantee the funding of local social and cultural projects. Moreover, the wind power in Arga is also expected to detain the demographic decay, as the local administration is believed to be able to offer better life conditions to the mountain inhabitants. In short, wind power represents now the opportunity of a "new order" for the region again.

10.4.3 Natural Park of Montesinho (PNM): The Commons at the Center of Negotiations

The Natural Park of Montesinho was established in the late 1970s in the extreme northeast of Portugal, often described as one of the most remote and wild regions in Europe with significant and rare natural resources. This protected area covers the region of the Montesinho and Coroa mountains and therefore the northern part of the municipalities of Bragança and Vinhais.

Although the exploration of wind power in the hills of Montesinho is still only an eventual possibility reclaimed by the local populations and authorities, while having strong opposition by the conservationists and nature tourism entrepreneurs, the negotiations and debates that are being promoted at the local level are reactivating old antagonisms.

Initially, during the discussion of a new planning scheme for the Natural Park of Montesinho, the ICNF argued for the total prohibition of wind farms within the nearly 75,000 ha of this protected zone. Later, the ICNF accepted its possible exploitation, under certain vaguely defined conditions and apparently related to political lobbying. This fuzzy process of decision making may be interpreted as the political result of the dilemma pitting conservationist policies against the threat of global warming.

In some of the parishes of the Natural Park of Montesinho, companies involved in the wind energy sector, foreseeing possible future permissions to construct wind farms in the protected area, have already rented some communal lands. Such a strategy of anticipation combines two main factors that leave the door open for future wind farms in Montesinho: the prospect of returns from the investment done by companies and the achievement of local acceptance, without much tensions and conflicts, at least in what concerns intra-community level.

The uses of the commons (*baldios*) have had in the past an important social function in the everyday practices of the community, contributing to attenuate social inequalities and allowing the subsistence of those who did not possess land, by giving them access to cultivation or collection of basic resources in the common lands. An assembly of neighbors manages those communal lands – a “neighbor” (a “comparte”) is the resident of a village, who has the right to explore the commons “according to tradition and custom’s laws”[4] usually established by the oral tradition transmitted across generations.

In the ongoing negotiations for the rental of lands where wind turbines could be installed, the neighbors’ representatives directly handle the contracts with the stakeholders (based on the expected power to be installed) for the benefit of the whole community. For instance, in the village of Aldeia de Montesinho, the money received has been invested to build up an irrigation network for communal use.

Wind power brought to these neighbors a high negotiable power, even a certain empowerment, reactivating and redirecting traditional collective uses, in decline, towards these unexpected winds of bonanza. At this time, the almost obsolete communitarian structures quickly became protagonists in a process that was not unnoticed to the companies, either from outside (which directly addressed them in order to sign rental contracts) or local companies (adding private interests, some village councils, and municipal investment) that without any experience in the renewable energy industry soon discovered that it could be interesting to invest in those so coveted commons.

The mere prospect of an eventual future construction of wind farms in the Natural Park of Montesinho has decisively contributed to the restructuring of important instruments of territory management – such as the long-awaited revision of the planning scheme. It has had a major role in the dynamics of traditional practices of landscape management, being the empowerment of the neighbors and the improvement of living conditions of the villagers the most visible local outcomes.

---

[4] Law N° 89/97 of 30 July.

10.5 Final Remarks

As we understand through the case studies conducted in protected areas, these physical spaces are now the subjects of new controversies with old protagonists: local populations, conservationist authorities from ICNF, local power.

Different perceptions of "landscape" traditionally coexist in the Portuguese-protected areas, sometimes conflicting with each other. On the one hand, the conservationists tend to valorize its scenic value in accordance with their perception of "landscape" as an abstract entity. On the other hand, local populations usually perceive the "landscape" as a legacy from their ancestors and a tangible place from which to extract a livelihood.

Reinforcing these antagonistic views, the discursive subjectivation of the scenic value of landscape has been emergent throughout the research, either by what has not been said or by what has been explicitly verbalized. Local opponents to wind power and conservationists avoid the issue and rather focus on other more tangible arguments (birds, noise, shadow, counterparts). Politicians prefer to discharge the argument of the visual impact as a matter of personal taste. The mayor of Montesinho, for instance, stated provocatively in one of our interviews: "the visual impact of the turbines is totally subjective, for me they look like flowers…."

Beyond that, our observations in the field illustrate how the implementation of wind power is encouraging local participation and revitalizing ancient structures of landscape management, in order to reclaim a share in the benefits of the exploration of their lands' resources. This is particularly notorious when the areas of wind potential are coincident with communal lands, which, as we have exposed, is frequently the case in protected areas.

The sudden and gigantic landing (either physical or economical) of wind farms in remote rural portions of the country, strongly dominated either by domestic agriculture or declining fragile industries, gave continuity to ancient conflicts around communal land uses and property rights, allowing to revitalize traditional informal local organizations (as village neighbors' assemblies) who used to manage the commons. Consequent revitalization and empowerment of such local structures contributed otherwise to reconfigure well-established quarrels that had always opposed local populations and governmental conservationist policies, represented by the ICNF.

On the other side, it is not difficult to acknowledge that the new landscapes of energy also constitute an important arena of negotiations, where stakeholders and local inhabitants all have something to gain with it. With this respect, it is interesting to note how the emergence of new landscapes of energy, so contested in other European countries (such as Germany, France, or the United Kingdom), has owned such pacific acceptance in Portugal. Even the usual conflictive interests, as those that usually oppose wind energy and tourism, for example, could be, in a certain way, neutralized, through strategic solutions and negotiations.

In a certain way, this conviviality is consonant with the idiosyncrasies of the country as regards landscape culture, either viewed from above (if we take national policies towards environmental issues) or from below (if we focus on local practices and processes under negotiation). Those key outcomes of the research clearly point to a decisive role of landscape for wind power deployment (Nadaï et al. 2013).

In what concerns Portugal, the economic dimension of wind power, meaning by this the fact that it is both local (distributed generation) and reinforced with an economic power (the promise of benefits) by the national feed-in framework (with transfer of value to city council), endows it with the capability to revitalize (and empower) ancient structures of landscape management during the local negotiation process. This becomes the occasion for local communities to contest the rules and regulations of nature protection institution, which imposes the national landscape as a shared norm (heritage), when landscape is shared as a practice on the local level (commons, property rights, agricultural production).

The embedding of wind power in local politics has followed different directions in the three situations – while in PNSAC negotiations took part between entrepreneurs and the municipality (institutional level), in PNM entrepreneurs rented the commons directly from the local, through their representatives at the "assembly of neighbors." A mixed participation occurred in Arga Mountain, where locals, entrepreneurs, and the municipality, altogether, figured out the displacement of some turbines in order to respect the shared religious value of the scenic landscape.

By means of the reclamation of communitarian property rights (commons), for (in Montesinho) or against (in Serra dos Candeeiros), or even "only if" (the turbines won't be seen from the monastery) in Serra d'Arga, wind power not only reveals the top-down dimension of nature protection; it also points at a positive dimension of landscape in wind exploration: the mere fact that such communities of practices are the channel through which this deployment gets embedded into the social.

Landscape, characterized here as a social process and a practice, is also a resource for the energy transition. Yet, when compared with other European countries, wind power has been much more controversial in Portugal. It does not only claim for an actualization of established institutional patterns regarding landscape management, but for a complete change in the way through which local societies and cultures get articulated with national environmental policies and landscape values.

References

Afonso AI, Mendes C (2010) Energía eólica y paisajes protegidos: Controversias en el parque natural de montesinho. Nimbus: Revista de climatología, meteorología y paisaje 25–26:5–20

Appadurai A (1996) Modernity at large. University of Minnesota Press, Minneapolis

Çalişkan K, Callon M (2009) Economization, part 1: shifting attention from the economy towards processes of economization. Econ Soc 38(3):369–398

DGEG – Direcção Geral de Energia e Geologia (2013) Renováveis. Estatísticas Rápidas 95

EUR-Lex (2009) Official Journal of the European Union, 5th April

Fernandez J (1986) Beyond metaphor: the theory of tropes in anthropology. Stanford University Press, Stanford

Hess D (2007) Alternative pathways in science and industry: activism, innovation, and the environment in an era of globalization. MIT Press, Cambridge

Latour B (2005) Reassembling the social: an introduction to actor-network-theory. Oxford University Press, Oxford/New York

Marx L (2000) The machine in the garden: technology and the pastoral ideal in America. Oxford University Press, Oxford/New York

Miller D (1998) Why some things matter. In: Miller D (ed) Material cultures: why some things matter. University of Chicago Press, Chicago, pp 3–21

Nadaï A, Krauss W, Afonso AI, Dracklé D, Hinkelbein O, Labussière O, Mendes C (2013) Une comparaison de l'émergence de paysages éoliens en France, Allemagne et Portugal. In: Terrasson D, Luginbuhl Y (eds) Paysage et Développement Durable. Quae, Paris, pp 157–169

Oliveira EV (1995) A Romaria de S. João d'Arga. In: Festividades cíclicas em Portugal. D. Quixote, Lisbon

Ramos MJ, Medeiros A, Sena P, Praça G (2003) Managing natural resources in Eastern Algarve, Portugal: an assessment of the policy uses of local knowledge(s). In: Pottier J, Bicker A, Sillitoe P (eds) Negotiating local knowledge: power and identity in development. Pluto Press, London, pp 155–170

Stoler AL (1995) Race and the education of desire: foucault's history of sexuality and the colonial order of things. Duke University Press, Durham/London

Wiliams R (1973) The country and the city. Oxford University Press, New York

Chapter 11
Of Other (Energy) Spaces

Protected Areas and Everyday Landscapes of Energy in the Southern Italian Region of Alta Murgia

Daniela Perrotti

Abstract This chapter features a case study in the southern Italian region of Puglia (Apulia), the rural area of Alta Murgia, which is partly included within the perimeter of the first National Rural Park in Italy (2004). We focus on the process of solar PV power development in these agricultural areas since the first Italian feed-in tariff system came into force (2005–2007). Fundamental to our purpose is to highlight the significant impacts of the political forces embodied in the planning process of these renewable energy projects. We consider not only the impacts on the socioeconomic development of the whole area over the last decade but also those on the landscape features and values that sustain and enable this development. National and regional renewable energy policies, on one hand, and the National Park Plan and Regulations, on the other, have engendered dramatically different consequences for the agricultural lands located inside and outside the perimeter of the protected area. The argument developed is that these two radically different approaches to the process of planning energy projects effectively reinforce the physical and symbolic gap existing between so-called particularly worthy landscapes and ordinary everyday landscapes (of energy). We highlight that the process of solar PV plant planning and development in the areas surrounding the Park has been essentially dominated and led by a sort of "site counter-logic." This actually resulted in a "counter-site logic." In the conclusion, we emphasize the potential for the planning process of green energy projects to act as an open-air laboratory for experimenting with a new integrated approach to energy, as both a notion and a natural fact.

Keywords Renewable energy planning • Rural Landscape • Energy policy • Italian feed-in tariffs • Post-carbon heterotopias

D. Perrotti (✉)
French National Institute for Agricultural Research, INRA Versailles-Grignon,
Research Network R2DS, Île-de-France Region, UMR SAD-APT INRA/AgroParisTech,
65, boulevard de Brandebourg, 94205 Ivry-sur-Seine Cedex, France
e-mail: daniela.perrotti@versailles.inra.fr

M. Frolova et al. (eds.), *Renewable Energies and European Landscapes*,
DOI 10.1007/978-94-017-9843-3_11

11.1 Green Energy: Still Bridging the Gap Between Physis and Techne?

In recent decades, a range of works in the literature has endeavored to explain how formal – often *at a distance* – demarcation and measurement of the environmental qualities of some particular landscapes have set the main criteria for identifying "acceptable locations" for renewable energy projects (Cowell 2010; Woods 2003; Hull 1995). As, for example, in the case of wind power development in Wales, the national and local debates about which particular sites could and should be the one most suited to the deployment of this technology challenge us to look critically at the main criteria adopted to evaluate the social and environmental acceptability of new energy projects.

In these public debates, one very relevant argument concerns the protection against the erosion by technology of those symbolic landscape values that are associated with the notion of *wilderness* or with the, nevertheless antithetical, idyllic or pastoral character widely attributed to rural lands (Woods 2003) and its recreational and scenic function (Pasqualetti et al. 2002; Brittan 2001). For example, Woods (2003) underlines that the "narratives of nature" elaborated in order to rationalize the "naturalness" of rural landscapes are sometimes supported by a "utilitarian perspective" which conceives nature as being "both wild and resilient." Nature as resilient can withstand human interventions (such as the generation of hydro- and wind power) and domesticate them; in this renewed framework, they would appear neither unnatural nor dangerous for the survival of nature.

As Cowell (2010) emphasizes, the vocation to secure values inherent to *rurality* against the deployment of wind power technology ultimately recalls two main archetypal issues. One is the conflict between "the countryside" and "the city," as illustrated by Lowe and Murdoch (2003) for the British planning system, in a work on three county branches of the Council for the Protection of Rural England. The other is the identification of wind power technologies with industrial, urban facilities, whose integration in the countryside consequently represents a critical issue for planning. As some authors underline referring to wind farms and their relationship to the landscape (Woods 2003; Brittan 2001), these plants are ultimately constantly "out" of something (e.g., a situation, a state, or a condition): "out of place," as they introduce large quantities of "alien materials" and "modern technology" into a supposed natural environment[1] (or "out of nature," in a non-neutral *natura-ruralist* perspective); "out of control," because of the uncertainty about how their expansion may be checked; "out of harmony" with their landscape; and "out of scale" with their physical environment, as they stand out in comparison with the leveled landscape features that surround them.

Our argument is that this approach to both the spatial and the symbolic dimensions of wind farms within *rurality* also illuminates the main logic behind the siting principles in the planning process. The aforementioned protective approaches to

[1] See the well-known metaphor of wind turbines as "mechanized weeds" Brittan (2001).

"unspoiled landscapes" (Woods 2003; Cowell 2010) seek mainly to preserve them from the deployment of *just another* technological or industrial development (renewable energy).

But what do these approaches teach us about what constitute (more) "acceptable," "suitable" locations (Cowell 2010; Cowell and Owens 1998) or "preferred areas" (Hull 1995) for wind power development, and so-called wind power envelopes (Nadaï and Labussière 2010, 2013a)? Which social expectations do they reflect?

If wind farms are deemed a priori inimical to nationally protected areas, e.g., National Parks,[2] because of these areas' statutory purposes of conserving natural beauty and heritage, then which are the main criteria established by policymakers to evaluate land outside specific designations? Is the fact of classifying a particular rural landscape as "industrial" or "modern agricultural" a satisfactory, pertinent argument for considering the development of wind turbines as an improvement (Wolsink 2007; Cowell 2010)? Or, as observed in recent controversies in the UK (Devine-Wright 2005), does the difference between "objective" and "subjective" landscape perceptions introduce a significant level of complexity that challenges easy categorizations of suitable and less suitable locations (often supported by public authorities and developers alike)? Are social and environmental justices undermined by channeling power plant development into physically or symbolically "spoiled" industrialized locations?

Referencing the work of Cresswell and Szerszynski, Cowell (2010) characterizes these locations as "profane," in contrast to the sacred value inherent in the natural environment; this characterization is particularly significant in those societies where land is "sacred, protected, scenic, or otherwise sensitive" (Pasqualetti 2000).[3] But to what extend does the demarcation of the specific values of some particular landscapes raise the issue of inequality both for landscapes and for the populations that inhabit them? In some contexts, this demarcation is seen as a key factor in establishing an evaluation grid for classifying areas as suitable and unsuitable for the development of renewable energy projects. Moving beyond the functionalistic distinction between suitable and unsuitable locations, what approaches to wind power planning and siting would stress the importance of the "relational interplay" between landscape and renewable power rather than focus on the mere issue of "territorial assignation" (Nadaï and Labussière 2013a)? Recent literature on a southern French case study in the Narbonnaise Regional Natural Park has shown how innovative approaches to planning might enable wind power to pull "familiar landscape into a new existence" (Nadaï and Labussière 2013a[4]).

---

[2] See also the "Areas of Outstanding Natural Beauty" in the UK regulatory framework, mentioned by the literature on wind power development in Welsh.

[3] By describing the example of one of the first wind farm projects in the USA, in San Gorgonio Pass (California), Pasqualetti (2000) highlights that the inhabitants of the nearby resort city Palm Spring claimed that wind turbines were "industrializing and thereby desecrating the principal gateway to their resort."

[4] See also Nadaï and Labussière (2010), Nadaï (2012).

These questions set up a critical framework for our analysis of the planning process and development of photovoltaic (PV) power plants in a *particular* rural landscape in southern Europe. Apart from some recent pioneering studies on large-scale projects in Spain (Espejo 2010; Frolova and Pérez Pérez 2008; Mérida et al. 2009, 2010; Prados 2008, 2010a, 2010b), the literature on the environmental and social acceptability of solar power technologies is less developed than that on the public attitudes and responses to wind power. However, the latter is well established and provides *lessons to be learned* for future debates or other energy technologies (Aitken 2010).

Our argument here is that in some regional contexts, such as the one analyzed in this chapter, a sort of "negative logic" or "counter-logic" seems to have been adopted in leading the whole process of planning and development of renewable energy projects. By identifying a negative logic, we intend to highlight that the process of establishing solar PV power plants in these areas has been determined mainly by regulations and restrictions on *particular* landscapes that have been progressively established by local and national energy policies. The literature provides a wide range of comparable case studies on the use of a zoning approach to wind power planning and siting (Aitken 2010; Cowell 2010; Ellis et al. 2009; Nadaï 2012; Nadaï and Labussière 2010, 2013a, b; Wolsink 2007). Sieve mapping methods, which are mainly aimed at mapping only regulatory constraints through the compilation of layers, are also a relevant example of this quantitative approach to wind power development. As Nadaï has recently emphasized in a French case study in the department of Aveyron, this approach is about turning the "what" into a "where." The question of "what type of landscape" to envision for the project site in the future is often replaced by that of "where" to locate wind farms in order to limit their impacts (Nadaï 2012).

By analyzing our case study, we intend to highlight how the negative logic behind so-called constraint planning approaches[5] (Nadaï and Labussière 2013a) has led to extensive development of solar PV power plants in "not particularly worthy" landscapes. This tendency is especially prominent in zones that are close to protected areas. In this context, unprotected areas have been considered as the opposite – or even the "negative" – of the conterminous protected areas, without consideration for the specific qualities inherent in these landscapes and their aesthetic and ecological values. These "other" spaces have been seen as merely *not specially* and *not particularly worthy* landscapes. For this reason, they have progressively become a sort of land reservoir for those activities that could not be established within in the protected areas.

[5] As regards to the traditional distinction between "constraint" and "positive" approaches to wind power planning, Nadaï and Labussière (2013a) highlight that the distinction between the two approaches lies not in the absence of recourse to constraint maps in the second but rather in how they are introduced into the planning process. For example, in the Narbonnaise case study that they analyze, the method adopted by planners consisted mainly in "opening up" the map forms. This is about endowing graphical representations with relational properties through the use of a multiplicity of graphical forms and specific practices of graphic designs and the adoption of an abductive mode of referencing the space.

11.2 Alta Murgia National Park and Alta Murgia Everyday Landscape: A Critical Relationship?

The southern Italian area of Alta Murgia is quite a significant example, given that our goal is to explore the notion of "alterity" that characterizes the relationship between *particularly worthy* landscapes and *everyday* landscapes. The interdependent relational properties with which these two kinds of landscape are endowed are key factors in understanding the limits and weaknesses of planning strategies based on enhancing the spatial, visual, and symbolic discontinuities between them.

Located in the hinterland of the Mediterranean town of Bari, in the Puglia (Apulia) region (Fig. 11.1a), this area has been historically devoted to intensive cereal production and livestock farming (ovine, bovine, and poultry). In 2004, about 68 ha of the Alta Murgia geographic region became a protected area: the Alta Murgia National Park. Moreover, this Park is totally circumscribed within a preexisting Site of Community Importance (SCI) and a Special Protection Area ("Murgia Alta" SPA), which was established in 1998 under the *Bird* Directive, 79/409/EEC. Extending over more than 143 ha, this SPA is part of the *Nature 2000* network.

The institution of the Alta Murgia National Park was particularly important not only in its impact on the evolutionary process of the area itself but also for the whole national legislative framework. In fact, Alta Murgia was the first Rural Park to be established in Italian territory. The definition of Rural Park differs from those of Natural and even Agricultural Park, which establish other administrative frameworks for Italian protected areas. The notion of "rural" is endowed with a particular meaning in the Alta Murgia context. Beyond the simple consideration of the area's physical features and the aim of protecting *natural* environments, the connotation of "rural" when applied to a National Park is intended to stress the importance of the whole set of relations established over time between "physical environment, history, human agency, and processes of landscape reclamation" (Castoro et al. 2005). With a radically different meaning and function than exclusively nature conservation, this rural protected area has been envisioned by local associations and political stakeholders as a *project*, gathering together different sociopolitical visions of this traditional agricultural region: protecting the natural, historical, and architectural heritage; regenerating and diversifying the local intensive monoculture farming; establishing a new system of low-impact "ecotourism"; and creating new professional opportunities in fields connected to the agricultural sector, including research and education (Castoro et al. 2005).

Furthermore, local administrators stress the dynamic approach of the political strategy they have adopted in order to ensure that the Park is not turned into a fixed, archaic, and anachronistic image of this territory. As explicitly mentioned in the Park *Action Plan*, which came into force in 2010, almost 6 years after the Park's establishment, this dynamic vision is rooted in the agricultural productivity and, more generally, the socioeconomic vitality of the area as a basic condition of its existence. In the Plan, this condition is considered in a dialectical relationship with

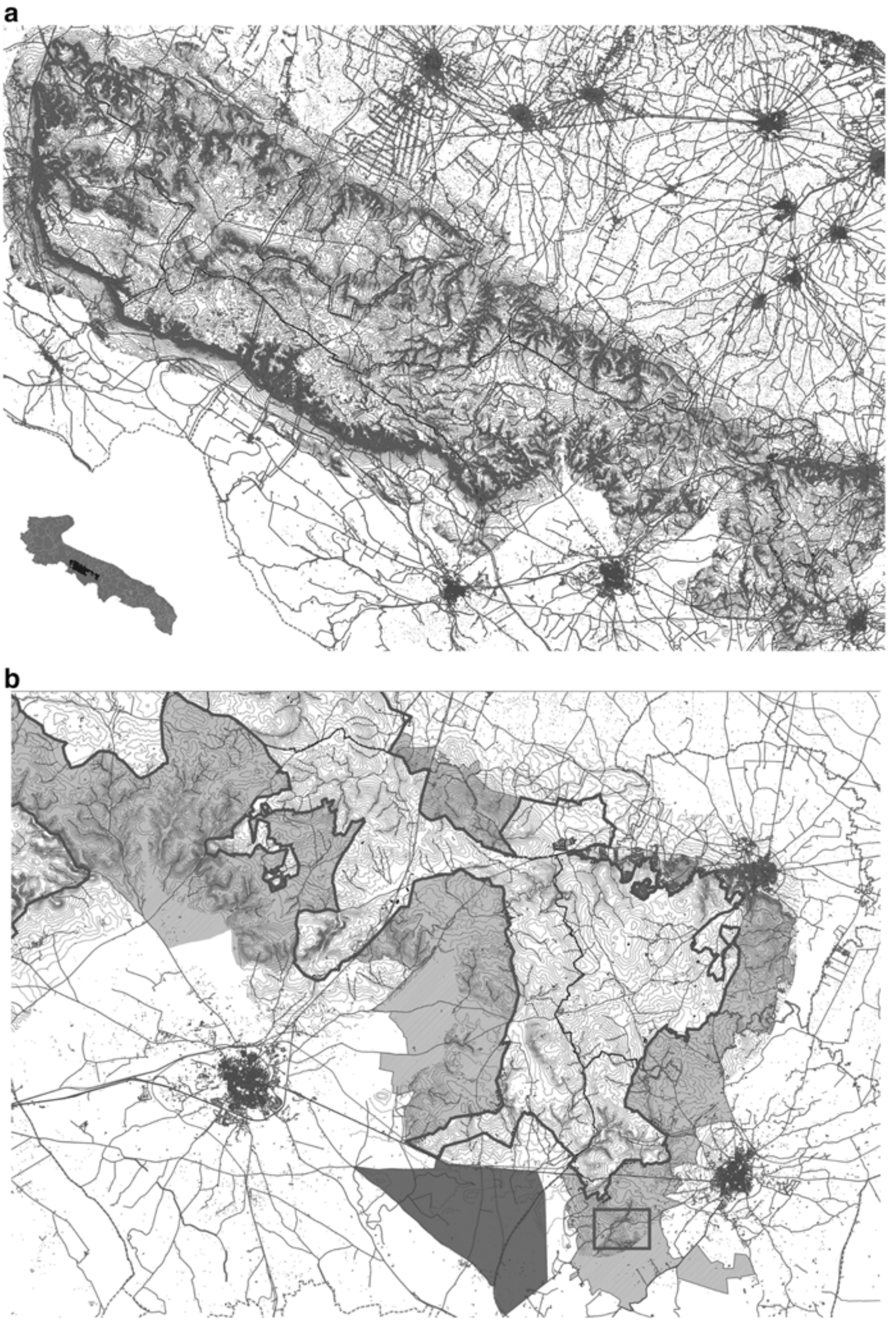

Fig. 11.1 (**a**) Perimeter of the Alta Murgia National Park and its localization in Puglia region (Adapted from Piano e Regolamento del Parco Nazionale dell'Alta Murgia 2010 Alta Murgia National Park Administration 2010a). (**b**) Perimeter of the south-eastern sector of the Alta Murgia National Park: the *light-gray* areas pinpoint the areas classified as "contiguous" to National Park boundaries, the *dark-gray* area pinpoints the area of Casal Sabini with extensive concentration of PV power plants (along the National Road SS 171 Altamura-Santeramo), and the *rectangle* pinpoints the rural archaeological area of the "Quite" (Adapted from Piano e Regolamento del Parco Nazionale dell'Alta Murgia, 2010. Carta della Zonizzazione. Zonizzazione D, revised in 2014, Alta Murgia National Park Administration 2010a)

the historical agricultural identity of the Alta Murgia landscape (Ente Parco Nazionale dell'Alta Murgia 2010).

Since its beginning, the new rural landscape infrastructure that the regulatory framework of the Park was intended to establish was potentially very open to new futures for Alta Murgia as a Rural Park and to experimentations with new forms of sustainability (Perrotti 2011).

But what role do renewable energies play in this context? How do they contribute to the foundation and development of the Alta Murgia Rural Park, as a *project*? What is the potential for renewable energy systems to challenge the landscape representations and perceptions of the local socioeconomic and political stakeholders? Even if not managed in a narrowly conservationist way, what are the counter-effects of the special value attributed to the lands within the protected area on the rest of the Alta Murgia region?

Our argument is that, despite the progressiveness of the adopted approach, the "ineluctable" heritage value that this regulatory framework assigns to the ecological and aesthetic features of the protected area seems to have worked against a thoughtful consideration of the whole Alta Murgia "everyday landscape". As mentioned above, this region extends far beyond the limits of the protected area. In fact, the extension of the perimeter of the protected area has been the subject of a long-lasting and controversial debate between administrators, residents, and associations, before and soon after the establishment of the Park (Castoro et al. 2005). Some actors have strongly emphasized the need to consider the lands located immediately outside the protected area as an integral part of the Park system, in order to preserve the identity and integrity of the whole Alta Murgia region, in both environmental and sociocultural terms.

The area directly outside the southeastern border of the Alta Murgia National Park, between the municipalities of Altamura and Santeramo in Colle, is very relevant in this sense. This part of the Alta Murgia geographical region includes an area of considerable ecological and cultural interest commonly known as "Quite," a few kilometers south of the town of Santeramo in Colle. This area is located outside the Park perimeter but classified as "contiguous[6]" in the Park Plan and Regulations (Figs. 11.1b and 11.2a). It falls within the boundary of the "Murgia Alta" Nature 2000 SPA mentioned above. This part of Alta Murgia has a significant concentration of rural and archaeological heritage. Over time, it has also become an important ecological patch and reservoir of biodiversity in the land mosaic of the region (Fracchiolla and Tedone 2009). *Quite* is the area with the most intact archaeological remains of the land allotment initiated at national level with the Agricultural Reform of the early nineteenth century, after expropriation of the richer landowners (Perrotti 2011). Each allotment[7] was delimited by low stone walls constructed with the

[6] "Aree contingue alla zona del Parco" (Ente Parco Nazionale dell'Alta Murgia 2010). As emphasized in the Park Action Plan, these particular areas outside the Park perimeter are important for two main reasons: the protection of the particular natural environments and of local wildlife species (e.g. Lesser Kestrel "falco grillaio"), and the preservation of continuous ecological corridors for flora and fauna.

[7] The local dialect word "quita" comes from the Italian "quota" (share).

Fig. 11.2 (**a**) 2009 aerial photograph of the rural archaeological area of the *Quite* (Puglia Regional Administration 2010a). (**b**) View of the rural archaeological area of the *Quite* from the Departmental Road SP 160 Santeramo-Jesce (© Daniela Perrotti 2010. Courtesy of Daniela Perrotti). (**c**) View of a PV power plant (1 MW) in the area of Casal Sabini, located along the National Road SS 171 Altamura-Santeramo (© Daniela Perrotti 2010. Courtesy of Daniela Perrotti)

chalky rocks collected after the process of land reclamation and the transformation of a karstic, stony soil into a surface suitable for cultivation. Historically, this process of de-stoning affected a significant part of the current Alta Murgia agricultural area (Ambrosi et al. 1990; Pastore 2007) and still characterizes the particular rural landscape of southeastern Alta Murgia today (Fig. 11.2b).

The reason that such an important part of the whole Alta Murgia cultural landscape could not be included within the protected area is the high, unsustainable level of anthropization that has characterized the development of those areas between *Quite* and the Alta Murgia National Park boundary. Indeed, this process of agricultural land "colonization" has been led mainly by the local stakeholders' commercial interests and with no adequate integration into regional spatial and landscape planning. It has thus engendered a scattered industrial landscape with no global vision and no real plan for the overall area. The increasing erosion of the *everyday landscape* values of these areas has been caused by the local industrial sprawl that resulted from a long series of "end-of-pipe" legal agreements between local administrations and industrial developers ("accordi di programma," Barbanente 2002).

A very relevant example is the rural area surrounding the hamlet of Casal Sabini, near two important infrastructure axes running along the southeastern border of the National Park: the branch of the SS 171 national road between the towns of Altamura and Santeramo and the local railway connecting the towns of Gioia del Colle and Rocchetta Sant'Antonio (Fig. 11.1b).

Located outside the boundaries of both the National Park and the larger "Murgia Alta" SPA, this area has seen a significant process of industrialization since an upholstered furniture district was established in the 1980s. The geographic area occupied by the manufacturing district is commonly called "il triangolo del salotto" ("the sofa triangle"), as it spans an area demarcated by three towns: Altamura, Gravina in Puglia, and Matera in the adjacent region of Basilicata (Viesti 2000; Baculo 1999). In the early 1990s, the district had already attained international importance, and the significant economic development of this sector had heavy impacts on this part of the Alta Murgia region, bringing radical changes in its landscape.

The process that led to the establishment of the protected rural area in 2004 was also seen by the local stakeholders and associations as an opportunity to limit this growing land-use trend and to minimize its impact in terms of agricultural land depletion and ecological disruption[8] (Barbanente 2002; Castoro et al. 2002). Obviously, the industrial areas and their surroundings were not included within the National Park, but the introduction of a stricter regulatory system deterred uncontrolled expansion of the manufacturing plants in the contiguous areas.

However, following a fairly common approach at both national and regional levels, investors have taken advantage of the major public incentives launched since the first Italian feed-in tariff system (2005–2007). Since then, what was known as the "the sofa triangle" has mostly been transformed into "the solar triangle."

Two main aspects of this process are relevant to our argument. On one hand, renewable energy policy at both national and regional levels has profoundly influenced the transformation of the agricultural "everyday landscape" of Alta Murgia into a new landscape of energy. On the other, the protected landscape approach translated into the energy policy level has massively contributed to increasing the spatial and symbolic gap between *particularly worthy* landscapes and *everyday* landscapes.

In the following sections we will highlight the policy framework that has engendered this dual approach to energy in *particularly worthy* landscapes and *everyday* landscapes. We will present the regional and local energy regulations that have been gradually established in the Puglia region and in the Alta Murgia area. We will consider them within the wider context of the national policy framework.

11.3 Guidelines, Regulations, and the Invention of Energy Landscapes

11.3.1 The Italian Policy Framework for Renewable Energy

The protected landscape approach, focusing mainly on safeguarding "particularly worthy" agricultural landscapes, is a very important pillar of one of the most influential instruments of Italian renewable energy policy: the National Guidelines for the Authorization of Renewable Energy Installations. These Guidelines were published in September 2010 by the Italian Ministry of Economic Development (2010). With this document the Italian government sought to implement a stricter authorization process regulating the installation of renewable energy power plants. The main goal of the National Guidelines was to ensure that these installations were appropriately integrated into the landscape. Indeed, the text made explicit reference to the European Community Directive 2001/77 on renewable energy production (European

[8] However, since 2003–2004, a progressive decline of the economic importance of such manufacturing area has been seen, partially as a result of the growing competitiveness of the Far East and East-Central Europe economies (Schiuma and Lombardi 2008).

Parliament and Council 2001), but also to the European Landscape Convention (ELC, Council of Europe 2000) and the Italian Code of Cultural and Landscape Heritage (Codice Urbani, Presidency of Italy 2004).

In the National Guidelines, the areas classified as "particularly worthy" are considered as not suitable for the development of renewable energy power plants (e.g., PV systems, wind farms, biomass-based power plants, geothermal and hydroelectric power stations) because of their theoretically special or unique heritage landscape value. However, this approach appears to conflict directly with the policy orientation envisioned at the European level during the implementation process of the ELC, which was based on the acknowledgment of the different qualities inherent in the landscapes of everyday life (Pedroli et al. 2007). One very important factor is the acknowledgment of the social, economic, and aesthetic values of "everyday landscapes" (ELC Article 2: Scope), such as highly productive rural landscapes with an intensive agricultural function.

These National Guidelines also aimed to counterbalance the extensive spread of solar PV power plants after the introduction of the feed-in tariff system, established by the Italian government for the first time in 2005. In fact, as for any other member state, the Italian strategy for achieving an effective energy transition is strictly conditioned by the global strategy set at the European Union (EU) level. In this supranational framework, Italy's national target for renewable energy was set at 17 % of its gross final energy consumption by 2020 (European Commission 2007). Indeed, since 2007, the Italian central government's engagement in EU Energy Policy was translated into the targets of 3,000 megawatts (MW) of nominal power to be provided by 2020 by PV installations and 16,000 MW by wind power.

In 2005, in response to the EU Directive 2001/77/EC,[9] the Italian Ministry of Production Activities (2005) introduced the first Italian feed-in tariff system regarding renewable energy, specifically conceived for supporting PV installations (Primo Conto Energia 2005–2007). This premium feed-in tariff scheme originally supported both small-scale (off-grid, max. 20 kW installed power capacity) and large-scale PV installations (grid connected, max. 1 MW installed power capacity) and with a bonus on top of the market electricity price for 20 years. Together with the decrease in the costs of PV panel components, the availability of the feed-in tariff premium led to a massive increase in the number of large-scale power plants.

As reported by the Italian Gestore dei Servizi Energetici (GSE), a publicly owned company promoting and supporting the development of renewable energy sources in Italy, in the national context as a whole, a significant increase in the number of power plants has been noted since the feed-in tariff system came into force: from 7,647 installations with a PV power potential of 87 MW in 2007 to 155,977 installations with a 3,469.9 MW power potential at the end of 2010 (GSE 2011a, b).

Between 2008 and 2013, this public incentive system was redesigned four times to reduce the impact on the electricity cost and on land use, especially for

[9] This EU Directive entered into force in Italy on December 2003 with the approval of the legislative Decree D.Lgs 29/12/2003 n. 387

ground-based PV plants.[10] In 2011, the tariffs were reduced by between 8 and 10 % for small plants and between 14 and 20 % for large plants; the final objective of this program is to achieve the "grid parity[11]" by the end of 2016 (GSE 2011b).

This incentive system of PV power development gave rise to important effects on agricultural lands, especially in traditional rural regions. In December 2010, Frascarelli and Ciliberti (2011) documented an increase of almost 150 % in ground-based PV installations over the previous year, i.e., 1,465.60 MW of the total power provided, and 42 % of the entire national PV potential. According to the 2011 GSE report (GSE 2011a), the total land allocated in Italy for solar PV energy production in 2010 (3,317 ha) represented about 0.026 % of the total land used for agricultural production. In the same year, the Puglia region had approximately 45 % of the whole national area occupied by PV ground-based plants, almost 1,484 ha, i.e., about 0.12 % of the total land used for agricultural production more than four times the national average (Gazheli and Di Corato 2011).

11.3.2 The Puglia Regional Policy Framework

Between December 2010 and January 2011, the implementation of the National Guidelines led each Italian regional government to establish a range of site-specific regulations as well as a management strategy for achieving a more balanced development process of the aforementioned different types of renewable energy power plants. These regulations took the form of Regional Guidelines that also introduced a set of local criteria classifications conceived to identify suitable and unsuitable areas for renewable energy plants. Puglia administration was among the first in Italy to develop its own Regional Guidelines (December 2010; Puglia Regional Administration 2010b). Their implementation required listing the areas unsuitable for siting green energy plants, in the Regional Land Inventory of Renewable Energy Sources.

In fact, the Regional Guidelines integrated the existing regional policy framework for renewable energy, which was formalized in 2007 through the enactment of the Regional Environmental Energy Plan[12] (PEAR Puglia). Strictly connected to the local territorial planning and land-use strategy, the Plan was established to clarify the role of renewable sources in the global energy supply system at the regional level.

[10] See the Second (2007–2010), Third (2010–11), Fourth (2011–12), and Fifth (2012–13) Energy Feed-In Tariffs. The first feed-in tariff system provided a fixed feed-in whose entity depended on the size of the plant, whereas in the following systems other criteria were introduced, such as the architectonic integration of the PV structure within the underlying building.

[11] Generation of electricity at a "levelized cost," less than or equal to the price of purchasing power from the electricity grid.

[12] Following publication of Regional Law no. 25 (September 2012), the PEAR should have been implemented in 2013 to ensure it is consistent with the 2010 National Guidelines. New regional green energy targets are to be defined, according to the responses from the region's municipalities to the regional authority's call to list, quantify, and monitor the total installed capacity by different types of green energy plant in each municipal sector (Puglia Regional Administration 2012).

The focus was also on green energy's potential contribution to regional economic development, especially in rural areas. The Plan has provided an estimate of supply and demand trends in different sectors (housing, commerce, industry, transport, agriculture, and fishing) in 10 year time after it came into force. The global assessment of the regional production of electricity between 1990 and 2004 (97.4 % from fossil sources and 2.7 % from renewables in 2004) shows how Puglia represents an important energy exporter at national level. In 2004, the region produced around twice as much electricity as it consumed. The region's energy exports have risen through intensive wind power production since 1997 and through the increase in the number of PV farms since 2005. In 2007, Puglia's share of green energy supply corresponded to 25.3 % of the national total for wind power and 13.4 % for PV power (Puglia Regional Administration 2007). The specific targets of 400 MW of wind power capacity and 40 MW of PV capacity to be installed by 2016 are seen as cornerstones of the regional environmental policy, namely, in reducing CO2 emissions, but also as a significant opportunity for stimulating the local economy and creating new development opportunities. Since the publication of the 2007 Plan, the regional authority has considered establishing adequate qualitative conditions for plant siting and the "widespread promotion" of green energy throughout the whole region as two main pillars of its future energy and environmental strategy.

In the new framework established by this regional policy, the agricultural sector has been seen as a key player in the local process of energy transition, as regards both supply and demand. However, over recent years, agriculture has mostly acted as an essential "land reservoir" for PV plant installations and not as a driver of change from fossil to biomass-based technologies. In fact, as the 2011 GSE report highlights, almost 3,375 ha of valuable agricultural land had been used for large-scale solar PV plant siting by the end of 2011, especially since the first national feed-in tariff system was implemented in 2005 (GSE 2011a).

Through the implementation of the Regional Guidelines, and the consequent introduction of both a stricter regulatory framework and a more controlled authorization process for renewable energy power plants, the local administration intended to tackle the indiscriminate spread of green energy plants in the countryside.

However, it is important to underline that, even before the publication of the Regional Guidelines, the Puglia administration had already implemented a regulatory framework for renewable energy planning, which formed part of the Regional Landscape and Territorial Plan[13] (PPTR Puglia, approved in January 2010a). This actually prohibited the installation of ground-based PV plants on agricultural land and authorized them only on the roofs of greenhouses and other agricultural structures, in industrial or urbanized areas (on roofs, facades, or parking lots), or in

[13] The contents of this section of the PPTR Puglia were established with regard to Regional Law no. 31, approved in October 2008 (Puglia regional administration 2008). This law was adjudged unconstitutional and abolished in 2010 by the Italian Supreme Court, which proclaimed that energy policy in Italy is under the exclusive jurisdiction of the central government, and the authorization processes for energy plant installations can only be regulated by ministerial decree.

abandoned quarries not involved in a rehabilitation process. These restrictions were established to limit the impacts of the National 2005 feed-in tariff system at the local level: distorted use of national incentives and green certificates, land-use conflicts, agricultural land depletion, desertion of traditional agricultural activities, increasing soil artificialization, inadequate land reclamation after power plant dismantling, etc. (Puglia Regional Administration 2010a).

11.4 On the Way to Sustainability, Alta Murgia Post-carbon Heterotopias

As in other Italian rural regions, since the implementation of the national incentive systems, the Alta Murgia farmers and landowners have considered the partial substitution of cereal production by ground-based PV plants as an opportunity for countering the negative economic trends seen over the last 20 years in the local agricultural and livestock sectors. Moreover, the implementation of green energy projects has been mostly perceived by local stakeholders as a key factor in achieving a more sustainable economic development at both local and regional levels (Viesti 2008).

Indeed, *sustainability* has represented what we may deem a "dominant metanarrative" (Selman 2010) underpinning the political discourse that has accompanied the long process of establishing the protected area (Barbanente 2002). As formalized in the 2010 Park Plan and Regulations, the ultimate aim of establishing this protected area was to nurture the traditional agricultural economy and to promote a "renewed model of sustainable territorial management of the National Park, in continuity with the local rural traditions" (Alta Murgia National Park Administration 2010a). Although, renewable energy represents a crucial issue in the Alta Murgia's quest for sustainability, sometimes engendering critical situations, conflicts, and controversies between local stakeholders.

The 2010 Park Plan and Regulations have established a rigid set of restrictions in the authorization process for solar PV power plants within the Park boundaries. The installation of ground-based energy plants on agricultural land is prohibited, and PV panels and solar thermal collectors are authorized exclusively on the roofs of farms, hangars, greenhouses, parking lots, and other agricultural or industrial structures, but only if their total height does not exceed 4 m. Moreover, if the solar panels are integrated on the roofs of buildings or structures of significant historical value, with regard to their architecture or their landscape setting, then the total occupied surface should not exceed 20 m^2.

In other words, any technological device that would alter either the ecological balance or the "ground and landscape morphology" is banned throughout Alta Murgia National Park (Alta Murgia National Park Administration 2010a), especially high-density and tall structure PV panel installations. In fact, their light reflections could affect the global perception of the landscape and could create risks not only for drivers on local roads but also for migrant fauna. The same measures were already listed in the 2004 Establishing Decree of the National Park, referencing the preexisting "Murgia Alta" SPA.

A crucial issue also emerged during the consultations that preceded the coming into force of the 2010 Regional Guidelines. These consultations involved various local authorities (regional, departmental, and municipal) and the administrators of the protected areas. The Alta Murgia National Park administrators emphasized the need to take account of areas unsuitable for the installation of green energy plants in the Regional Land Inventory. This concerned not only the areas within the Park perimeter but also the areas immediately outside, even those not included in the Nature 2000 "Murgia Alta" Site.

This debate highlighted the significant impact of the system of regulations and restrictions for National Park protected areas on their conterminous lands, specifically as regards the siting process of renewable power plants. In fact, in recent years, it is precisely the Alta Murgia areas surrounding the zones within the national protection that have been affected by the development of solar PV power plants, whose construction is not authorized within the Park perimeter.

Relevant to our point is note no. 4123 sent in November 2010 by the Director of the Alta Murgia National Park to the Vice president of the Puglia Regional Administration and the Head of the Regional Environmental Council (Alta Murgia National Park Administration 2010b). This note followed the discussion concerning the regional implementation of the National Guidelines: "The Park is now virtually being encircled by power plants that are already installed, or about to be, just outside its boundary. The significant consequence of this process is that the natural patches of protected area are being progressively insularized by the disturbance of ecological continuity."

However, there is evidence that the process of insularization affects not only the ecological features of the protected areas but also the sociocultural and economic dynamics that are embedded in the whole Alta Murgia landscape. In our view, this process represents a counter-effect of the "protected landscape approach" on which the Alta Murgia National Park regulations have been based.

For example, since 2005, an increasing number of land-based PV plants have been established on the agricultural lands surrounding the hamlet of Casal Sabini (about 6 km away from the rural archaeological site of *Quite*) running along the aforementioned SS 171 national road and the local railway Gioia-Rocchetta Sant'Antonio (Fig. 11.1b). Most of them occupy a surface of 2 or 3 ha and reach 1 MW of installed power capacity, the limit set at national level to comply with the eligibility conditions for the public incentive system provided by the first feed-in tariff system (Fig. 11.2c).

For two of the biggest solar fields in this area (one fixed installation and one with mono-axial sun trackers), local farmers have leased their land for 25 years to the private company First Solar, a society engaged in PV power generation and belonging the Uni Land Group.[14] The same group owns four other solar PV power plants in the south of Puglia region, with the same installed power capacity (1 MW). The project design, the PV panels supply, and the whole process of the plant's construction were provided by the Chinese group LDK Solar Co.,[15] with which in 2009, the Italian group Uni Land has signed a partnership agreement for the development of several PV plants in 2011–2012, for a total power capacity of 20 MW. The two Alta Murgia 1 MW PV plants were the first to be constructed in the frame of this Italo-Chinese partnership agreement.

These plants provide a typical example of the landscape of scattered PV fields that have emerged in rural Puglia in the absence of strict regulations for the authorization. The Casal Sabini "solar" landscape highlights the lack of integration of the renewable energy projects in the areas outside the Park perimeter in the regional planning process. The installation of these plants has contributed to transforming an "everyday landscape" of agriculture production into a juxtaposition of symbolically and spatially closed enclaves, in other terms, a post-carbon landscape of renewable energy plant sprawl (Prados 2010a). These areas appear as the product of a strictly functional *zoning* approach applied to the local planning process. Here, the functions of energy supply, on the one hand, and agricultural production, on the other, have been made to coexist with no consideration of the possible reciprocal "synergies" (Schöbel and Dittrich 2010). The lands occupied by PV plants are totally closed and inaccessible, with no interactions nor overlap between these two functions.

To some extent, these spatial solar energy enclaves may also be seen as the postmodern counterpoint to the social demand for "high-quality" landscapes, which are mostly considered as the (only) ones endowed with aesthetic and ecological values. In this sense, we may define these renewable energy extensive productive areas as a new kind of contemporary, postmodern heterotopia. They provide space for all *other* activities that appear not strictly compatible with those spaces that embody people's common expectations for "rural" or "natural" protected areas. As Foucauldian heterotopias, these places are outside of all places, even though it may be possible to indicate their physical location on a map. They are also endowed with the other main characteristics of these "counter-sites," being "in relation to all other sites but in such a way as to suspend, neutralize, or invert the sets of relations that they happen to designate, mirror or reflect" (Dehaene and De Cauter 2008). The PV power plants developed in the area of Casal Sabini have not been conceived as potential

[14] Uni Land operates not only in the sector of renewable energies development (especially PV and, more recently, wind plants) but also in the house-building sector, real estate franchising, and land banking (covering the management of the process of changing the land use, from agricultural to residential or commercial/industrial destination). It is the first society operating in these sectors to be listed on the Italian stock market. It was providing financial support for the development of the two aforementioned Alta Murgia PV power plants.

[15] Founded in 2005, the Chinese LDK Solar Co., Ltd. is a world leader in the production of integrated PV systems and their components (panels, modules, cells). It also provides the design and the project management of PV systems.

structural components of the landscape in which they are installed but, on the contrary, as *other*, different entities, disconnected from their local environment.

11.5 Experimenting with Green Energy Forms and Perceptions in Everyday Landscapes

What is particularly evident in the area of Casal Sabini is the contrast between the application of the renewable energy Guidelines to the agricultural areas considered "particularly worthy" (and integrated into a protected system and a strictly regulated normative framework) and to all other "everyday landscapes."

Moreover, the fact of confining green energy production to isolated, secluded areas (the "negative" counterpole of what is commonly considered and assessed as a "particularly worthy" landscape) could be seen as a result of the character of *otherness*[16], which seems to be associated with green energy. Apart from the identification with postmodern, contemporary heterotopias, the *otherness* of green energy plants with respect to their landscape context recalls another main issue mentioned in the introduction: the "out of place"/"out of nature" condition attributed to wind farms by certain authors, such as Brittan (2001) and Woods (2003). This condition appears paradoxical, if we consider that the "alien materials" and "modern technology" that constitute renewable power plants are introduced in a supposedly natural environment in order to synthesize and convert natural wind or solar energy into power.

These final considerations raise questions on the technological language adopted by engineering to construct renewable energy systems. Our argument is that this language does not effectively translate the role of solar and wind energy into the construction of everyday landscapes of life. Paradoxically, the technological equipment developed in the area of Casal Sabini seems to widen the gap between the social perception of renewable energy and the landscape in which it is *embedded*. Renewable energy is still rarely perceived as a natural phenomenon and a structural component of the landscape where power plants are located. Since the rise of ecology – intended as the study of nature in terms of matter, energy, and organization (Odum 1971) – in spatial planning and design, some authors have stressed that the landscape is basically a physical expression and result of the interactions between "on-site" energies and materials[17] (Williams 2007).

A clearer vision of how energy is embodied and circulates in living systems (photosynthesis, primary production and respiration, hydrological cycle, etc.) may also contribute to increasing knowledge of the contribution of energy flows in

[16] Also in the sense of a "certain 'romance' of marginality" evoked by Harvey (2000).

[17] See also the work of one of the pioneers of permaculture, Bill Mollison (1988).

structuring and organizing our physical environment and all forms of life within it (Perrotti 2014).

In this renewed approach to green energy and its potential in structuring the landscape, a significant role should be played by landscape planning and design of solar and wind power plants in order to achieve a deeper understanding of what green power effectively is, where it originates, and what are the biological processes that enable its assimilation. Following this perspective, the land devoted to solar energy production should no more be seen by policymakers, planners and inhabitants as secluded enclaves, completely disconnected from the landscape structure that embraces them and provides added values. On the contrary, these decentralized renewable energy infrastructures could be envisioned as the "recomposition of socio-technical links between landscape and energy" (Nadaï and van der Horst 2010). In other terms, they represent a significant opportunity to initiate a process of co-construction of a "landscape of reconciliation" (Schöbel and Dittrich 2010). The goal would be to develop and facilitate multiple levels of synergies between different stakeholders, and multiple interactions between the socioeconomic, cultural, and ecological features of future landscapes. However, this major goal for spatial planners, policymakers, and engineers cannot be achieved without an attempt at a more harmonious integration of the renewable energy plants into *their* landscape. This attempt might consist in conceiving planning processes that would be more "open" to the *logics* of the specific project site.

A relevant example is the "micro-siting" approach adopted in 2001 by the French Bird Protection Organization (LPO) in the development of a wind power project (repowering of an existing station) within the Narbonnaise Regional Natural Park in southwestern France (Nadaï and Labussière 2010). This experimental method of bird-watching was aimed at understanding and mapping how birds behaved in and reacted to a specific site where turbines were made to coexist with a migration corridor.[18] The method embodies an "intermediary" view between protection and planning. By composing space with birds, planners can allow the new wind power landscape to emerge from a "net of relations" between the birds, the wind, the turbines, the project developers, the bird-watchers, and, ultimately, the site. In Narbonnaise, wind power development is an opportunity not only to show how birds and turbines can coexist and share the "same" wind but also to transform birds' intelligence in interacting with the wind (and their strategies for dealing with turbines) into a "readable" quality of the landscape. In other words, an innovative way to approach wind power planning and *micro*-siting could result from "converting relations into other relations" (Nadaï and Labussière 2010).

[18] The 2001 LPO survey was aimed at "rendering the moving presence of birds" by translating bird behaviors into textual and visual representations.

11.6 Conclusions

Returning to our case study in southeast Alta Murgia, the question arises as to what strategies local planners and developers could follow to introduce a specific micro-siting approach to PV power planning. In more general terms, what should be the local *drivers* for a development process that is more "open" to the *logics* of the project site?

In Narbonnaise, an *aesthetic of the movement* seems to emerge as a leading force in the wind power planning process. It evokes the presence of the birds and of living systems within this landscape. At the same time, it translates the specific "wind-related kinetics" embedded in the project field into a *sensory* experience (Nadaï and Labussière 2010).

In the very different karstic landscape of the Alta Murgia region, it is more the *stasis* of geological time than the *kinesis* of the local living forces that could reactualize the heterogeneous network of relations between the local entities. The geomorphological features of the Alta Murgia landscape and the specific lithological character of its calcareous soil (and subsoil) have influenced the development of a site-specific typology of architecture and a typical spatial organization for the local rural settlements. Hence, it is on these transcalar and transtemporal entities (geology and lithology) that planners should focus to conceive new spatial configurations of the everyday energy landscapes in Alta Murgia.

One very relevant agent of this (re)composition process are the stone walls built with the chalky rocks collected during the reclamation of the Alta Murgia's karstic soil. As mentioned above, these walls are still visible in the rural archaeological area of the *Quite* which lies only a few kilometers away from the PV power development area of Casal Sabini. The land allotments that they once delimited were the physical translation of the notion of "share[19]," applied to the specific political and socioeconomic organization of the site. A *quita* was the expression of the share of the work, symbolizing the individual's responsibility toward the community. As a means of apportionment, the chalky stone embodied the measure of the heterogeneous forms of relations within Alta Murgia's rural society: a multiplicity of relationships, between the local inhabitants, between them and the political power and/or the economic laws, and, ultimately, between these material and immaterial forces and the site. The *Quite* stone walls were the forms in which the Alta Murgia civilization materialized, obviously, in tight interdependence with the specific landscape features of the site. Hence, the Alta Murgia chalk-stone walls are the materialization of *the measure* in the network of relationships that have structured and, to some extent, still characterize the organization of Alta Murgia's rural society today (Perrotti 2011). These stone structures, a continuum on the regional topographic structure (Fig. 11.3a), compose a shared field of connections between the local material and immaterial entities.

[19] See note 7.

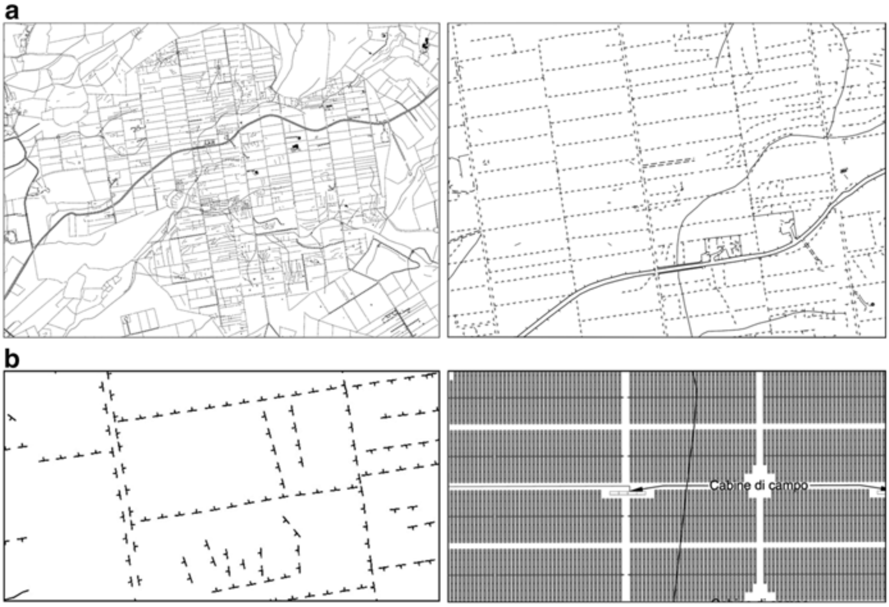

Fig. 11.3 (**a**) Stone wall grid with hydrographical network (and detail) in the rural archaeological area of the *Quite* (Adapted from Puglia CTR Carta Tecnica Regionale, 2010). (**b**) Spatial and dimensional relationship between the meshes of the stone wall grid in the *Quite* area and the strings of solar panels of a PV plant in the area of Casal Sabini (Adapted from Puglia CTR Carta Tecnica Regionale, 2010)

Are the Alta Murgia's stone walls there to suggest to planners that a less *de-measured* approach to the new landscapes of energy transition is possible? Do they advocate a more "measured" relationship between energy and society (i.e., a more moderate consumption of natural resources)?

When taking the form of boundary walls or other rural structures, the stone in Alta Murgia represents a *measure* of both time and space. Its geological scale may interplay with the diachronic temporality of solar energy, making the latter more tangible and readable within *its* landscape. Also, the grid that the stone walls draw on the Alta Murgia soil has great potential to inspire the forms and organization of future solar fields (Fig. 11.3b); hence, they might potentially be the agent of a new process of planning and design, more open to the specific logic of the site and its spatial organization.

It is in this sense that (everyday) energy landscapes (Perrotti 2012), such as the southeastern Alta Murgia, may be seen as an open-air laboratory for experimenting with new methods and languages of renewable energies as essential, structural components of these landscapes (Perrotti 2014). Ultimately, this renewed *eco-logical* and cultural approach to energies in nature could represent a step forward in repositioning green energy projects more clearly within our sensory, cognitive, and, thus, *aesthetic* horizons.

References

Aitken M (2010) Why we still don't understand the social aspects of wind power: a critique of key assumptions within the literature. Energy Policy 38(4):1834–1841. doi:10.1016/j.enpol.2009.11.060

Alta Murgia National Park Administration (2010a) May 31. Piano e regolamento del Parco Nazionale dell'Alta Murgia. Alta Murgia National Park Administration, Gravina di Puglia. http://www.parcoaltamurgia.gov.it/index.php?option=com_content&view=article&id=270. Accessed 13 Feb 2013

Alta Murgia National Park Administration (2010b) November 29, Nota n 4123. 'Provvedimento regionale in attuazione delle "Linee guida" per l'autorizzazione degli impianti alimentati da fonti rinnovabili di cui al DM. 10 settembre 2010. Trasmissione osservazioni alla bozza in fase di definizione'. Gravina di Puglia

Ambrosi A, Degano E, Zaccaria CA (eds) (1990) L'architettura in pietra a secco. Schena Editore, Fasano

Baculo L (1999) Il salotto: Altamura, Matera e Santeramo. In: Cersosimo D (ed) Città, Paesi, Distretti. Trame e nodi della realtà meridionale. Meridiana Libri, Corigliano Calabro

Barbanente A (2002) Il 'Distretto del Salotto' e il processo di istituzione del Parco. In: Studi per il Piano di Area dell'Alta Murgia, Rapporto Finale, Parte III, 'Economia, piani e politiche di sviluppo' III.24 – III.32. Politecnico, Dipartimento di Architettura e Urbanistica, Regione Bari, Puglia, Provincia di Bari

Brittan GG Jr (2001) Wind, energy, landscape: reconciling nature and technology. Philos Geogr 4(2):169–184

Castoro P et al (2002) Il processo di istituzione del Parco: visioni 'esterne' e 'interne'. In: Studi per il Piano di Area dell'Alta Murgia, Rapporto Finale, Parte VI, 'Comunicazione, valutazione e gestione'. IV.7 - IV.29. Politecnico, Dipartimento di Architettura e Urbanistica. Bari, Regione Puglia, Provincia di Bari

Castoro P, Creanza A, Perrone N (eds) (2005) Guida al Parco dell'Alta Murgia. Natura e storia del primo Parco Rurale d'Italia, Torre di Nebbia, Altamura-Bari

Council of Europe (2000) September 20 European Landscape Convention. Council of Europe, Strasbourg. http://conventions.coe.int/Treaty/en/Treaties/Html/176.htm. Accessed 17 Feb 2013

Cowell R (2010) Wind power, landscape and strategic, spatial planning–the construction of 'acceptable locations' in Wales. Land Use Policy 27:222–232. doi:10.1016/j.landusepol.2009.01.006

Cowell R, Owens S (1998) Suitable locations: equity and sustainability in the minerals planning process. Reg Stud 32(9):797–811. doi:10.1080/00343409850117960

Dehaene M, De Cauter L (2008) Heterotopia in a postcivil society. In: Heterotopia and the city. Routledge, New York, pp 3–10

Devine-Wright P (2005) Beyond NIMBYism: towards an integrated framework for understanding public perceptions of wind energy. Wind Energy 8:125–139. doi:10.1002/we.124

Ellis G, Cowell R, Warren C, Strachan P, Szarka J, Hadwin R, Miner P, Wolsink M, Nadaï A (2009) Wind power: is there a 'planning problem'? Expanding wind power: a problem of planning, or of perception? The problems of planning - a developer's perspective wind farms: more respectful and open debate needed, not less planning: problem 'carrier' or problem 'source'? 'Innovative' wind power planning. Plann Theory Pract 10(4):521–547. doi:10.1080/14649350903441555

Espejo C (2010) Los nuevos paisajes de la energía solar. Las centrales termosolares. Nimbus 25–26:65–91

European Commission (2007) January 10 Communication from the Commission to the European Council and the European Parliament: An Energy Policy for Europe. COM(2007) 1 final. European Commission, Brussels. http://www.managenergy.net/resources/881

European Parliament and Council (2001) September 27. Directive 2001/77/EC on the Promotion of Electricity Produced from Renewable Energy Sources in the Internal Electricity Market. EP and Council, Brussels. http://eurlex.europa.eu/smartapi/cgi/sga_doc?smartapi!celexplus!prod!CELEXnumdoc&numdoc=32001L0077&lg=EN. Accessed 12 Feb 2013
Fracchiolla M, Tedone L (2009) Indagini preliminari sulla flora spontanea in ex coltivi della Murgia nord-occidentale. Italian J Agron/Rivista di Agronomia 4:935–942
Frascarelli A, Ciliberti S (2011) La diffusione del fotovoltaico in Italia e l'impatto sull'agricoltura. Agriregionieuropa 24:31–34
Frolova M, Pérez Pérez B (2008) El desarrollo de las energías renovables y el paisaje: algunas bases para la implementación de la Convención Europea del Paisaje en la política energética española. Cuadernos Geográficos de la Universidad de Granada 43:289–309
Gazheli A, Di Corato L (2011) Land-use change and solar energy production: a real option approach, Climate change and sustainable development series, Fondazione Eni Enrico Mattei, working papers. Paper 641. http://services.bepress.com/feem/paper641. Accessed 26 Feb 2013
GSE (2011a) Rapporto Statistico 2010: Solare fotovoltaico http://www.gse.it/attivita/statistiche/Documents/Solare%20fotovoltaico%20-%20Rapporto%20Statistico%202010.pdf. Accessed 20 Feb 2013
GSE (2011b) Incentivazione degli impianti fotovoltaici: relazione delle attività 2010. http://www.gse.it/media/Pubblicazioni/Rapporto%20Fotovoltaico/Rapporto_FTV2010_Finale.pdf. Accessed 21 Feb 2013
Harvey D (2000) Spaces of hope. Edinburgh University Press, Edinburgh
Hull A (1995) New models for implementation theory: striking a consensus on wind-farms. J Environ Plan Manag 38(3):285–307. doi:10.1080/09640569512887
Italian Ministry of Economic Development (2010) September 10. Decreto Ministeriale, 'Linee guida per l'autorizzazione alla costruzione e all'esercizio di impianti di produzione di elettricità da fonti rinnovabili nonché linee guida tecniche per gli impianti stessi'. Gazzetta Ufficiale, n. 219 (Sep 18, 2010). http://www.provincia.milano.it/export/sites/default/ambiente/doc/n_energia_2010_DM_Sviluppo_Economico_10_09_2010.pdf. Accessed 17 Feb 2013
Italian Ministry of Production Activities (2005) July 28, Decreto Ministeriale, 'Criteri per l'incentivazione della produzione di energia elettrica mediante conversione fotovoltaica della fonte solare'. Gazzetta Ufficiale, n 181 (Aug 5, 2005). http://www.autorita.energia.it/it/docs/riferimenti/decreto_050728.htm. Accessed 27 Feb 2013
Lowe P, Murdoch J (2003) Mediating the 'national' and the 'local' in the environmental planning process: a case study of the CPRE. Govern Policy 21(5):761–778. doi:10.1068/c0024j
Mérida Rodríguez MF, Pérez Pérez B, Lobón Martín RL, Frolova M (2009) Hacia la caracterización del paisaje de energías renovables. In: Pillet Capdepón F, Cañizares Ruiz MC, Ruiz Pulpón AR (eds) Geografía, territorio y paisaje: el estado de la cuestion. Actas del XXI congreso de geografos españoles. Ciudad Real, 27–29 de octubre de 2009, pp 1193–1210
Mérida Rodríguez MF, Lobón Martín RL, Perles Roselló MJ (2010) Las plantas fotovoltaicas en el paisaje. Tipificación de impactos y directrices de Integración paisajística. Nimbus 25–26:129–154
Mollison B (1988) Permaculture a designer's manual. Tagari, Tyalgum
Nadaï A (2012) Planning with the missing masses: innovative wind power planning in France. In: Szarka J, Cowell R, Ellis G, Strachan P, Warren C (eds) Learning from wind power: governance, societal and policy perspectives on sustainable energy. Palgrave Mac Millan, Basingstoke, pp 108–132
Nadaï A, Labussière O (2010) Birds, turbines and the making of wind power landscape in South France (Aude). Landsc Res 35(2):209–233. doi:10.1080/01426390903557964
Nadaï A, Labussière O (2013a) Playing with the line, channelling multiplicity – wind power planning in the Narbonnaise (Aude, France). Environ Plann D Soc Space 31(1):116–139. doi:10.1068/d22610
Nadaï A, Labussière O (2013b) Wind power and the emergence of the Beauce landscape (Eure-et-Loir, France). Landsc Res 38. doi:10.1080/01426397.2013.784732

Nadaï A, van der Horst D (2010) Introduction: landscapes of energies. Landsc Res 35(2):143–155. doi:10.1080/01426390903557543

Odum HT (1971) Environment, power and society. Wiley, New York

Pasqualetti MJ (2000) Morality, space, and the power of wind-energy landscapes. Geogr Rev 90(3):381–394. doi:10.1111/j.1931-0846.2000.tb00343.x

Pasqualetti MJ, Gipe P, Righter RW (2002) A landscape of power. In: Pasqualetti MJ (ed) Wind power in view. Energy landscapes in a crowded world. Academic, San Diego, pp 3–16

Pastore P (ed) (2007) Architettura tradizionale in Puglia. Adda Editore, Bari

Pedroli B, van Elsen T, van Mansvelt JD (2007) Values of rural landscapes in Europe: inspiration or by-product? NJAS–Wageningen J Life Sci 54(4):431–447. doi:10.1016/S1573-5214(07)80014-5

Perrotti D (2011) Il Parco Nazionale dell'Alta Murgia. Un paesaggio, Italian Ministry for the Environment. Edizioni L'Orbicolare, Milano

Perrotti D (2012) Conceiving the (everyday) landscape of energy as a transcalar infrastructural device: the progressive construction of a working hypothesis. Projets de paysage 7, http://www.projetsdepaysage.fr/fr/conceiving_the_everyday_landscape_of_energy_as_a_transcalar_infrastructural_device. Accessed 17 Feb 2013

Perrotti D (2014) Landscape as energy infrastructure: ecologic approaches and aesthetic implications of design. In: Czechowski D, Hauck T, Hausladen G (eds) Revising green infrastructure: concepts between nature and design. CRC Press, Boca Raton, pp 71–90

Prados MJ (2008) Solar latifundia in Andalusia: how solar energy transforms cultural landscapes, in landscapes, identities and development. Paper presented at PECSRL 2008 23rd Session. 'Landscapes, identities and development', Lisbon/Obidos, Portugal. http://tercud.ulusofona.pt/PECSRL/Presentations/Solar_latifundia.pdf. Accessed 23 Jan 2013

Prados MJ (2010a) Renewable energy policy and landscape management in Andalusia, Spain: the facts. Energy Policy 38(11):6900–6909. doi:10.1016/j.enpol.2010.07.005

Prados MJ (2010b) ¿Energías renovables o agricultura? Un análisis de la percepción sobre los huertos y latifundios solares en Andalucía. Nimbus: Revista de climatología, meteorología y paisaje 25–26:205–229

Presidency of Italy (2004) January 22. Decreto Legislativo n42, 'Codice dei beni culturali e del paesaggio'. Gazzetta Ufficiale, n45 (Feb 24, 2004) http://www.camera.it/parlam/leggi/deleghe/04042dl.htm. Accessed 19 Feb 2013

Puglia Regional Administration (2007) June 8. Piano Energetico Ambientale Regionale (PEAR Puglia) Bari. http://www.regione.puglia.it/index.php?page=progetti&opz=downfile&id=319. Accessed 20 Feb 2013

Puglia Regional Administration (2008) *October 21*. Legge regionale n 31, 'Norme in materia di produzione di energia da fonti rinnovabili e per la riduzione di immissioni inquinanti e in materia ambientale'. Bollettino Ufficiale della Regione Puglia, n. 167 (October 10, 2008). http://www.regione.puglia.it/index.php?anno=xxxix&page=burp&opz=getfile&file=5.htm&num=167. Accessed 21 Feb 2013

Puglia Regional Administration (2010a) January 11. Piano Paesaggistico Territoriale Puglia (PPTR Puglia), Bari. http://paesaggio.regione.puglia.it/index.php/area-download/-a-breve-i-materiali-della-proposta-pptr.html. Accessed 17 Jan 2013

Puglia Regional Administration (2010b) December 30. Regolamento Regionale n 24, 'Linee Guida per l'autorizzazione degli impianti alimentati da fonti rinnovabili', recante la individuazione di aree e siti non idonei alla installazione di specifiche tipologie di impianti alimentati da fonti rinnovabili nel territorio della Regione Puglia. Bollettino Ufficiale della Regione Puglia, n. 195 (Dec 31, 2010). http://www.regione.puglia.it/index.php?page=burp&opz=getfile&file=1.htm&anno=xli&num=195. Accessed 12 Jan 2013

Puglia Regional Administration (2012) September 24 Legge Regionale no. 25, 'Regolazione dell'uso dell'energia da fonti rinnovabili', Bollettino Ufficiale della Regione Puglia, n. 138 suppl. (Sep 25, 2012). http://enerweb.casaccia.enea.it/enearegioni/UserFiles/Puglia/N138%20suppl_25_09_12.pdf. Accessed 10 Jan 2013

Schiuma G, Lombardi P (2008) La domanda di innovazione della filiera del mobile imbottito in Puglia. Quaderni ARTI 6:15–35

Schöbel S, Dittrich A (2010) Renewable energies. Landscape of reconciliation? Topos 70:56–61

Selman P (2010) Learning to love the landscape of carbon-neutrality. Landsc Res 35(2):157–171. doi:10.1080/01426390903560414

Williams DE (2007) Sustainable design, ecology, architecture and planning. Wiley, Hoboken

Wolsink M (2007) Wind power implementation: the nature of public attitudes: equity and fairness instead of 'backyard motives'. Renew Sust Energ Rev 11(6):1188–1207. doi:10.1016/j.rser.2005.10.005

Woods M (2003) Conflicting environmental visions of the rural: windfarm development in mid Wales. Sociol Rural 43(3):271–288. doi:10.1111/1467-9523.00245

Viesti G (2000) Il triangolo del salotto. In: Viesti G Mezzogiorno dei distretti. Meridiana Libri, Corigliano Calabro, pp 97–118

Viesti G (2008) Le Energie Rinnovabili in Puglia: Strategie, competenze, progetti. Quaderni ARTI 5:16–54

Chapter 12
Wind Energy and Natural Parks in European Countries (Spain, France and Germany)

Michel Deshaies and Daniel Herrero-Luque

Abstract The rapid development of wind power in Europe has led to a debate about the most suitable location for new sites, in which the need to install turbines in areas with high wind potential must be balanced against their inevitable impact on the landscape and other environmental concerns. Conflicts can arise because wind turbines tend to be located in natural areas on which they have a strong visual impact, especially as there is a widespread belief that landscapes are immutable. Wind energy development also encounters local opposition when decisions are perceived as being externally imposed to the benefit of others from outside the area. There is a commonly held notion that wind farms should not be installed in natural parks, given that their function is to preserve natural and cultural landscapes of high value. This chapter however demonstrates that the situation regarding wind power development in these parks varies enormously, as in many of them the natural conditions for wind power development are very favourable. We analyse wind power development in natural parks in three European countries (Spain, Germany and France) in which the number of wind power projects has grown significantly over the last decade. Wind farms have been installed in natural parks in all of these countries. In France and Spain, this development has been restricted to small areas considered of low cultural and natural heritage value. In Germany, by contrast, some natural parks have a high concentration of wind farms, while others remain free of any wind power development. The aim of this chapter is to analyse the forces driving the development of wind power in these protected areas and to identify the differences between the three countries under consideration.

Keywords Protected areas • Landscape protection • Wind power development • Natural park • National park

---

M. Deshaies (✉)
University of Lorraine, Campus Lettres et Sciences Humaines,
23 boulevard Albert 1er, 54000 Nancy, France
e-mail: michel.deshaies@univ-lorraine.fr

D. Herrero-Luque
Departamento de Geografía, Facultad de Filosofía y Letras, University of Valladolid,
Plaza del Campus s/n, 47011 Valladolid, Spain
e-mail: herrero@geo.uva.es

M. Frolova et al. (eds.), *Renewable Energies and European Landscapes*,
DOI 10.1007/978-94-017-9843-3_12

12.1 Introduction

Over the past 15 years, the proliferation of wind farms across the countryside has changed the image and perception of landscapes in many European countries, leading to ‘the emergence of new energy landscapes’ (Nadaï and Labussière 2013). The process of wind power development has however been far from uniform, with wide variations not only across Europe but also within each individual country. While wind turbines have become part of the landscape in Northern and Eastern Germany, in Galicia and Castilla y León in Spain and in the cereal plains of the Paris Basin, they are very few and far between in Aquitaine and Provence, in Bavaria or in the Mediterranean regions of Spain. These differences in the distribution of wind farms only partially reflect the differences in wind potential.

Lines can also be drawn between regions in which wind power projects have spread quickly with little resistance and other areas in which only minimum development has occurred. One reason is that natural park managers, and sometimes local government and local residents, perceive wind turbines as a threat to the quality of the landscape and the preservation of wildlife. We therefore decided to analyse the relationship between natural park policy and wind power development in order to identify the causes of conflict and to determine the principal factors affecting the deployment of wind farms in protected landscapes. Given that the exact definitions and nomenclature vary from one country to the next, in this chapter we will be using the term ‘natural park’ as an all-embracing concept describing protected natural areas and ‘national park’ as the standard term used to describe the most important protected areas in each country.

12.2 Opposition to Wind Power Projects Arising from Landscape Concerns

12.2.1 Growing Impact on the Landscape

Over the last 15 years, wind power has experienced the sharpest growth of all renewable energy sources with worldwide installed power increasing from 17,000 MW in 2000 to 318,000 MW in 2013. However, although wind turbines have now been installed in more than a hundred countries, the bulk of installed capacity is highly concentrated, with three quarters of it in five countries: China, the United States, Germany, Spain and India. France, meanwhile, is just behind India in the ranking, albeit with an installed capacity three times lower. In many regions of these countries, wind turbines have thus become characteristic elements of the landscape. The development of wind energy cannot go unnoticed as wind turbines are large machines, which have increased rapidly in size over the last decade. While the machines of the 1990s reached a maximum nacelle height of 70 m, with blades spanning 30–45 m, today’s wind turbines are typically 3 MW machines with a nacelle height of over 100 m and a 90 m blade span. In the coming years, demand for these very large machines is expected to multiply, particularly in the context of the repowering projects currently booming in Germany (Table 12.1).

Table 12.1 Development of onshore wind farms in Germany, Spain and France (installed capacity in MW). AEE, IDAE, BMU (2012; GWEC 2013)

Year	2000	2005	2013	2020[a]
Germany	6,095	18,415	34,350	45,000
Spain	2,535	10,028	22,959	35,000
France	68	757	8,254	19,000

[a]National targets: in France, Germany and Spain 'National Renewable Energy Action plans', 2010

12.2.2 The Grounds for Opposition to Wind Power

Wind turbines alter the visual characteristics of landscapes, raising many objections at a local level. Sometimes these objections are channelled through more or less organized opposition movements, whose motivations vary from one place to another and are not always easy to define. It would be wrong, for example, to generalize and brand them all as NIMBY (not in my backyard) movements (Wolsink 2000, 2007; Aitken 2010). Depending on the region, opponents to wind power projects focus on the dangers of wind turbines for birds or bats (Johnson et al. 2004; Lilley and Firestone 2008; IUCN 2008), on the noise generated by the machines or on the allegedly harmful consequences for the image of the landscape and its attractiveness for tourists (Möller 2006; Lilley et al. 2010). According to Pasqualetti (2011) who studied several cases in the United States, Mexico and the United Kingdom, the reasons for opposition to wind power projects can be divided into five categories:

- The particular characteristics of the wind resource mean that it is best exploited via wind farms with a high concentration of turbines, which are difficult to integrate into the landscape.
- The widespread belief in the immutable character of familiar landscapes.
- The role of the landscape in the construction of local identities.
- The perception of wind power projects as being externally imposed for the benefit of people from outside the region.
- The threat posed by wind power projects to local identity.

Wind power development has led to 'the emergence of new energy landscapes' (Nadaï and van der Horst 2010; Selman 2010; Nadaï and Labussière 2013), and the way in which they are perceived is influenced by the specific institutional framework in each country (Nadaï et al. 2013). The values given to these newly shaped landscapes largely depend on the national traditions of landscape protection, which vary significantly from one country to another.

In France, landscape management is part of a centralized tradition that follows a similar system to that used with historic heritage, namely, that the surrounding area should be free of any elements that would spoil the view of the monument, a notion referred to as 'degrading co-visibility' (Nadaï 2007; Nadaï and Labussière 2013). As a result the State retains full responsibility for wind energy planning from which local residents are largely excluded, with only very limited public consultation.

In Germany, the role of local councils and the *Länder* (regional governments) is much more important than that of the federal government in decisions regarding the location of wind farms. Local people are closely involved in the management of landscapes that have been transformed by wind energy expansion. In some regions, they are also directly involved in the development of wind farms which are owned by cooperatives and other community groups (Krauss 2010).

In Spain, landscape management is the responsibility of regional governments, who also play an important role in wind power deployment (Frolova 2010). As a result, the development of wind energy has been far from homogeneous in the different regions. In addition to geographical differences and landscape diversity, Spanish regions have their own legislative framework and their own 'territorial culture'. Local authorities, meanwhile, have a very limited role in the decision-making process, as 'there is no tradition of involving local communities in land-use and landscape management' (Frolova and Pérez Pérez 2008: 296).

In spite of these differences in landscape management, wind power development has spawned opposition movements in the three countries we are studying here, especially in the name of landscape protection.

12.2.3 Natural Parks as Areas of Landscape Protection

Opposition to wind power projects often seems related with a fear that the turbines will be a 'blot on the landscape', so diminishing its quality. Given that these and similar protection areas were set up amongst other reasons in order to help preserve high quality landscapes, it may seem strange that the installation of wind turbines in natural parks could even be contemplated. However, the objectives and protection status vary considerably depending on the type of park. In all three countries, national parks have the strictest landscape protection criteria, while regional parks and nature reserves have a more permissive status. So while the installation of wind turbines is prohibited in national parks (in France only the central areas enjoy absolute protection), it is possible in most other protected areas, albeit under specific conditions (Table 12.2).

In Spain, there are more than 40 categories of protected areas recognized by the laws of the 17 autonomous regions. In protected areas, there are restrictions affecting both developers and local people, for example, on the building of new power plants (Troitiño Vinuesa et al. 2005). Law 4/1989 distinguishes four types of park, namely, natural park, national park, rural park and regional park. These four categories occupy about 62.4 % of Spain's total protected area of 42,310 km^2. Over 1,200 towns and villages lie within the socioeconomic sphere of influence of these parks.

Natural, regional and rural parks in Spain, regional natural parks in France and 'Naturparks' in Germany mainly cover rural landscapes shaped by traditional agri-

Table 12.2 Types of natural parks

Type of park	Objectives	Managing authority	Position on wind energy
National park (France)	Preservation of territories with exceptional cultural and natural heritage	Public institution (national)	Prohibited in the central area
			Possible in the peripheral area, if compatible with the objective of conservation of species and habitats
Regional and natural park (France)	Collaborative project of sustainable development, based on the protection and enhancement of natural and cultural heritage in sensitive rural areas	Board made up of representatives of regional authorities and community groups	Possible in all areas where there is no threat to cultural and natural heritage
			Development of wind power maps/plans in some regional parks
National park (Germany)	Conservation of natural areas little affected by human activities	Federal agency for nature conservation	Prohibited
Regional and natural park – Naturpark (Germany)	Nature preservation and sustainable development	Regional government	Possible in all areas, where there is no threat to cultural and natural heritage
National park (Spain)	To help protect and complete the biodiversity and natural characteristics of Spain	Regional government is responsible for normal, day-to-day management	Prohibited
	To guarantee a favourable state of conservation	Central government coordinates the National Park Network and intervenes in special cases	
Regional and natural park (Spain)	Conservation of ecological, aesthetic, educational and scientific values	Regional government	Varies depending on rules established in the 'Uses and Management Master Plan' for each park

cultural activities. In the three counties under consideration, these landscapes are considered of aesthetic importance and deserving of protection, amongst other reasons because they are important assets and resources for the development of green tourism. As can be seen in some park management plans (Table 12.2), the aim of natural parks is to protect these landscapes.

12.2.4 Natural Parks and the Development of Wind Turbines

In many cases the development of renewable energy is considered compatible with the protected status of natural parks and is even one of their objectives. As a renewable energy source, wind power is often considered part of sustainable development, because it can provide new economic resources for people living inside the protected areas. The income from wind power is redistributed in very different ways in the different countries. In Germany, wind farms are often developed by cooperatives. In France and Spain, municipalities and regions receive part of the profits from wind power via a wind power tax, which is often a welcome source of revenue for the budgets of small rural communities (Nadaï and Labussière 2013). This can result in a conflict between the financial interests of towns vying to host a wind farm and the objectives of park management authorities responsible for landscape protection. But has this apparent contradiction between wind energy development and landscape protection actually prevented the installation of wind turbines in natural parks?

To answer this question, we have analysed the distribution of wind farms in relation to the size of the different parks in the countries under consideration (Fig. 12.1). We mapped the wind farms in the three countries on the basis of information available on the following websites: 'The Wind Power'[1] for France and Germany and the Wind Energy Association[2] (AEE) for Spain. Striking contrasts could be observed between Spain, Germany and France, as well as between different regions in each country (Fig. 12.1). These protected areas have not escaped the development of wind power, although on the whole, wind turbines are less common inside parks than outside them. Significant differences can also be observed from one natural park to another. These differences result from the chronology of the development of wind power as well as from the specific policy pursued by the local authority managing the park vis-à-vis wind energy. The perception of wind turbines by the local population is itself highly variable from one region or park to another and makes the likelihood of opposition difficult to predict. Many factors must be taken into account in order to understand the distribution of wind farms in parks, including local opposition, park regulations and wildlife protection (i.e. Natura 2000 areas).

The total area covered by these parks also varies from one country to another. In Germany, natural parks occupy about a quarter of the country; in France, they cover 13 and 8 % in Spain (Table 12.3). The total installed wind power capacity is higher in Germany (34.3 GW, 2013) and Spain (23 GW, 2013) than in France (8.2 GW, 2013), where wind power development took off much later (since 2005). Population density is another factor to take into account. France and Spain are characterized by vast areas of low population density (less than 20 inhabitants/km^2) in which many of the natural parks are found. Population densities in Germany are much higher, with natural parks themselves housing an average of over 60 inhabitants/km^2. As a

[1] http://www.thewindpower.net

[2] http://www.aeeolica.org/

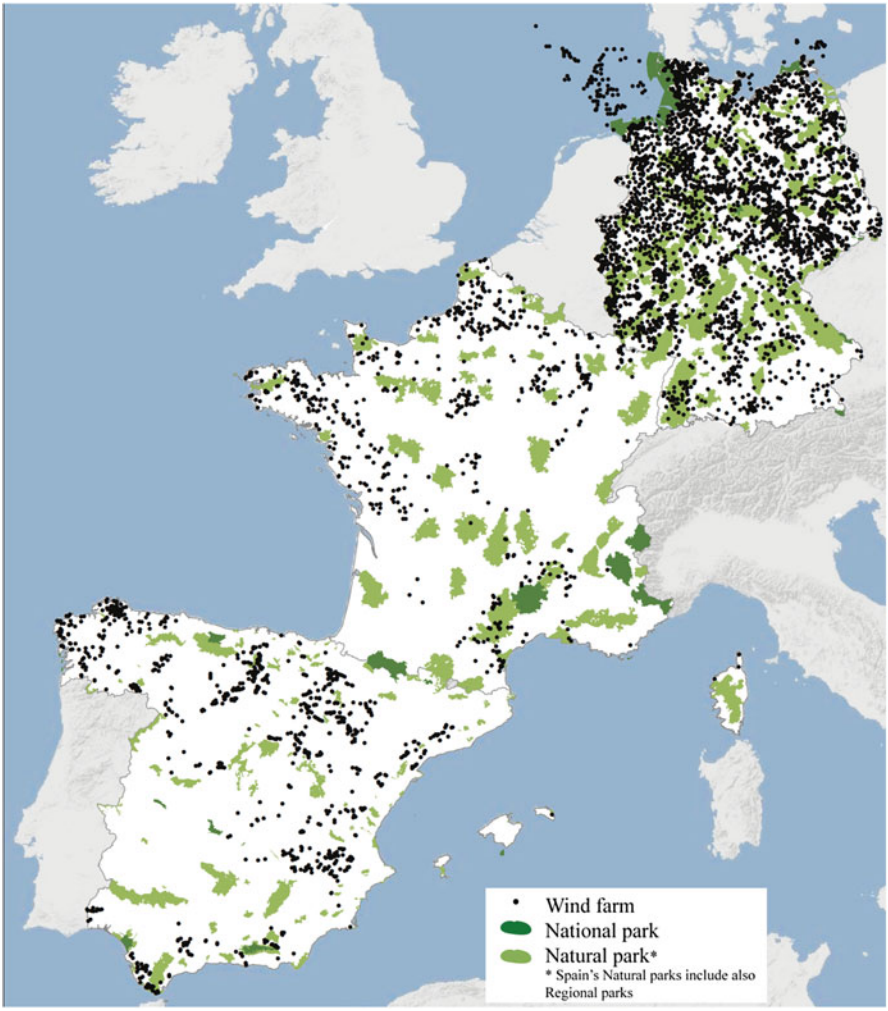

Fig. 12.1 Distribution of wind farms in Germany, France and Spain. AEE, www.thewindpower.net

Table 12.3 Natural parks in Germany, Spain and France

Country	Number	Total area (km^2)	% country area
Germany	104	89,200	25
Spain	119	42,310	8
France	48	72,400	13

result, wind farms are located relatively close to populated areas in Germany, whereas in France and especially in Spain, they are often sited a long way off.

Finally, the different approaches to energy planning in the three countries must also be taken into account. In Germany, the development of a wind farm must be authorized by the town council and must comply with federal and regional laws (Krauss 2010). In France, since 2006, turbines can benefit from a feed-in tariff if they are located in a ZDE (wind power development zone). These zones are proposed by the municipalities and approved by the local representative of the State (departmental prefect). In Spain, the regions have the decision-making powers, and local authorities play only a very limited role in the process.

12.3 Limitations on Wind Farm Development in Spanish Natural Parks

In Spain, regional and local management roles limit the expansion of wind farms and other infrastructures in national, regional and natural parks (Prados et al. 2012). The few parks including wind farms (e.g. Hoces del Alto Ebro y Rudrón in the region of Castilla y León and Los Alcornocales in Andalusia) do so because the park management plan was drawn up after the turbines had been installed. In the case of the Hoces del Alto Ebro y Rudrón natural park, 65 wind turbines were built between 1999 and 2001, whereas the park management plan only came into effect in 2007. In spite of this development, this park remains, locally, the area with the lowest density of wind turbines.

In some cases a ban on the construction of wind farms in natural parks was imposed retroactively, and existing facilities were dismantled before the park officially came into being. For example, the oldest wind farm in Catalonia, located along the Costa Brava, was dismantled in August 2007, prior to the application of the 'Special Plan for the protection of the environment and landscape of the Natural Park of Cap de Creus' (Ariza-Montobbio and Farrell 2012).

Interestingly, local people often support the development of wind farms in protected areas. Although they are generally excluded from the planning process, they view wind farms as a way of generating economic returns from otherwise often 'unproductive' land in areas in which industrial and other forms of development are tightly controlled. This favourable local opinion often contrasts with that of regional government and conservationist groups who reject the development of wind power in natural parks (e.g. Natural Park of Ojo Guareña (Burgos), Natural Park of Lago de Sanabria y alrededores (Zamora)). These conflicts are frequently the result of environmental and landscape policies that are drawn up without participative planning processes, in which all interested parties can express their opinions (Afonso and Mendes 2010).

The location of protected natural and cultural heritage areas in Spain is confined to the mountainous areas and wetlands. By contrast, the large inland plains cultivated with cereals, vineyards and olive groves or used for grazing and forestry (*dehesa*) are not normally considered landscapes worthy of protection, especially by the central government. Communications infrastructures, high-voltage power lines, wind farms and golf courses have all been constructed in these areas.

12.4 The Diversity of Situations in Natural Parks in France

In France the situation is different as there are no laws prohibiting the development of wind farms in natural or regional parks (PNRs). As a result, about a dozen PNRs have welcomed the development of wind farms. Of these, only three are intensely colonized by wind farms: the Narbonnaise, the Haut Languedoc and the Grands Causses. These parks are located in some of the windiest parts of France, the sites of the country's first wind farms.

In fact, the first wind farms in France were installed in the Narbonnaise natural park in 2000. The number of turbines has multiplied since the farm's creation on a plateau of scrubland overlooking the coastal plain. Wind power then spread inland to the Haut Languedoc and Grands Causses natural parks, where it mostly occupied abandoned farmland. This development prompted opposition movements, anti-wind farm NGOs, such as the Hurlevent (Stormwind) association,[3] who oppose 'industrial wind power', which they claim degrades the landscape, especially in the foothills in the Haut-Languedoc natural park. According to Nadaï and Labussière (2009, 2013) the emergence of local opposition in the Grands Causses natural park is linked to the undesired effects of a local wind power plan issued in 2005.

Indeed, in order to regulate the very fast development of wind power, the local administration drafted a planning document defining areas considered suitable for wind farm development and areas in which it was seen as conflicting with various environmental and heritage constraints. In the preamble to this document, it states that park authorities are generally favourable to the development of renewable energy, which they conceive as part of sustainable development and a way to fight global warming.

While wind energy is perceived as a means of increasing the share of renewable energy in the natural park area, its development must be strictly controlled and restricted to areas of limited landscape sensitivity. As stated in another PNR planning document: 'yes, to wind power, but not anywhere or in any way' (PNR Livradois-Forez 2009). Despite these local wind power planning documents, many parks have struggled to contain the development of wind turbines in peripheral areas, where landscape sensitivity is perceived as less important. The Grands Causses PNR is an emblematic case in point. Its 11 wind farms, with a total of 54 wind turbines, are all located on the edges of the park and in the lower areas where they have less co-visibility and impact on the landscape. The most recent permits

[3] www.hurlevent.org

have been granted for turbines located in these areas, while 126 projects located in the higher, most iconic plateaux were denied permits.

In fact, the areas where wind farms can potentially be developed are limited by:

- Co-visibility with natural and cultural heritage sites
- The proximity of residential areas (the turbines must be located at least 500 m away)

As a result wind power development has been forbidden in almost all natural parks. This is the case, for example, of the Loire-Anjou natural park, located on the Val de Loire UNESCO World Heritage Site, in which the recommendation that wind farms should not be visible from the Loire Valley directly excluded almost half the park (PNR Loire-Anjou-Touraine 2009).

If one takes into account the expanse covered by the natural protected areas and the dispersed settlement patterns, the space available for windmill installation is quite limited. However, planning in the form of zoning is not always enough to avoid conflict as Nadaï and Labussière (2013) found in the case of Haut Languedoc and Aveyron (Grands Causses natural park). Zoning restrictions have resulted in an excessive concentration of wind turbines in areas considered favourable, so triggering opposition in these areas. The critical analysis of the inadequacies of administrative planning in the Narbonnaise PNR (Nadaï and Labussière 2013) suggests that we need to discard an approach based almost exclusively on centrally planned zoning and open the planning process to the participation of different local stakeholders.

12.5 The Development of Wind Farms in Natural Parks in Germany

12.5.1 Many Wind Farms in German Natural Parks

The case of Germany is perhaps the most interesting and complex, due to the scale of wind power expansion, making it the country with the highest installed capacity in Europe. Statistics show a rapid growth in the number and density of wind turbines, particularly in the north and the east of the country above all between 1998 and 2012. By the end of 2013, about 23,000 turbines had been installed in Germany, amounting to about one wind turbine per 15 km^2 (Germany has an area of about 357,000 km^2) making the average density of wind turbines in the country ten times higher than in France and about twice as high as in Spain. At the same time Germany has a large number of natural parks covering approximately a quarter of its total area, most of which are in relatively high altitude areas (Mittelgebirge) or on the northern plains (moraine hills), areas with high wind potential. A blanket exclusion of wind energy from natural parks would therefore reduce its possibilities drastically. A flexible approach has therefore been adopted with the result that there are many more wind turbines in natural parks in Germany than in France or Spain. In Germany, wind farm projects must be authorized by the municipalities and must comply with federal and regional environmental laws.

12.5.2 Large Differences in the Concentration of Wind Turbines

The distribution of wind turbines varies a great deal across the country and within the different *Länder*. Only a dozen *Naturparks* have a large number of wind turbines, while 37 parks have none at all. The other 55 natural parks have a relatively small number of wind turbines, generally located on the edges of the protected area. In fact, most of Germany's natural parks are characterized by a well-below-average number of turbines in the surrounding areas and therefore to some extent constrain wind power development. However, the density of the deployment of wind farms in natural parks is very uneven due to several factors, such as varying regional approaches to wind energy. Another factor is the type of landscape in that large numbers of wind farms have been installed in polder landscapes in Germany and open-field landscapes in France, while enclosed landscapes in France and Germany's many forests are clearly less favourable locations. The age of the natural parks is also important in that the first *Naturparks* were created in the 1950s, while many other parks were set up after 2000 coinciding with the rapid expansion of wind power.

Paradoxically, there is no clear relation between the concentration of wind turbines in natural parks and their density across the region. The distribution of natural parks and wind farms at the national level reveals a high density of wind turbines in the North and of natural parks in the South. However, if we focus on the presence of wind farms in parks, we observe that this is a common occurrence in southern Germany, where the turbine density is lower. In the same way, if we compare northern Germany, which has three quarters of the installed wind power capacity, with the regions in the South (Bavaria and Baden-Württemberg) where wind power development remains limited, the distribution seems very unequal. Despite this, more than half the *Naturparks* without turbines are located in northern Germany, or in the new *Länder*[4] in the former East Germany, in areas with a high density of wind turbines. This is the case of the natural parks in Mecklenburg-Vorpommern and the Lüneburg Heath in Lower Saxony. Even in Schleswig-Holstein, the *Land* with the highest density of wind turbines (about 2,700 in total about 1 for every 6 km^2), two natural parks (Westensee, Aukrug) have no wind turbines at all, and the other three (Holsteinische Schweiz, Hüttener Berge and Lauenburgische Seen) have only very few.

[4] Länder is the plural of Land.

In the new *Länder*, the vast majority of natural parks have very few wind turbines, and some have none at all. However, there are exceptions due to the parks being founded at different times. This is the case of two neighbouring *Naturparks*, Hohe Fläming in Brandenburg and Fläming in Saxony-Anhalt. While the former has only one turbine, which is located near the perimeter, the latter has over two dozen. This is largely due to the fact that the Fläming natural park was founded in 2005, after many wind turbines had been installed in the area, while the Hohe Fläming park was established in 1997, before the expansion of wind power. It would be wrong however to jump to the conclusion that wind turbines can only be found in recently established parks because some of the oldest *Naturparks* in Germany also have a lot of turbines. These include, for example, Vogelsberg (1956) considered the oldest in Germany, Nordeifel (1960), Teutoburg-Eggegebirge (1965), Elbhöhen-Wendland (1968) and Altmühltal (1969). One of the striking, perhaps contradictory, features of the Altmühltal park and of North Schwarzwald and Schwarzwald Mitte (in the southern *Länder* of Bavaria and Baden-Württemberg) is that wind turbines are relatively more concentrated inside the parks than in the surrounding areas. Finally, there seems to be no clear pattern within each region, as in many cases within the same *Land*, there are some natural parks with a large number of wind turbines and others with none at all.

12.5.3 Reasons for the Uneven Distribution of Wind Farms in Natural Parks

There are various reasons for the differences in the density of wind turbines from one park to another. It is partly the result of regulations and partly due to varying perceptions as to whether or not turbines are compatible with the landscape and the environment. Numerous opinion polls (Günther 2002; Weise et al. 2002; Benkenstein et al. 2003; SOKO-Institsut Bielefeld GmbH 2005; Vogel 2005; FORSA 2007; Ratzbor 2011; IfR 2012), conducted in Germany to evaluate the perception of wind turbines of local residents and tourists in different regions, revealed that about two-thirds of respondents did not consider them to be annoying and did not feel that they degraded the landscape. There is also no evidence of any reduction in the number of tourists visiting the coastal areas of the North Sea after large numbers of wind turbines had been installed there. But in most surveys undertaken between 2000 and 2012, regardless of the region concerned, there is always a group of around 30 % of those interviewed who regard them as quite annoying and a small fraction (often less than 10 %) who express a very negative opinion. The number of opponents as a percentage of the population does not appear to have increased in recent years, despite the rise in the number of wind turbines, as shown in another survey conducted in summer 2012 in the North Eifel natural park (IfR 2012). However, even a minority opinion can have a decisive influence on infrastructure projects, by mobilizing opposition using the right resources. It should also be noted, as shown by Aitken (2010), that opinion polls 'remain contentious as a method for examining public attitudes and responses' and 'that public attitudes are not stable but rather adaptable and changing'. It is therefore difficult to predict public reaction to wind farm projects in natural parks, although we can at least try to identify the conditions in which such projects are most likely to be accepted.

12.6 Most Favourable Conditions for the Installation of Wind Turbines in Natural Parks

12.6.1 Preferable Location in Peripheral Areas

The distribution of wind turbines in natural parks varies so much from one country to another and even within the same country that it is extremely difficult to establish any coherent pattern. The age of the natural park, for example, does not seem to be a discriminating factor in that, as we have seen in Germany, there are many old natural parks with large numbers of wind turbines, and some of them, such as the Vogelsberg and North Eifel natural parks, were the birthplace of wind power in their regions. In France, we find the same variations in age in natural parks with large numbers of wind turbines. Contrasting examples include the Narbonnaise, a relatively young park established in 2003 subsequent to the first wind energy developments, and the Haut-Languedoc (founded in 1973), one of the oldest parks in France.

However, in almost all natural parks with wind turbines, they tend to be located on the periphery far away from the central most iconic areas with high landscape values. The areas generally regarded as unsuitable for wind turbines include high or mountainous areas, those in close proximity to protected natural areas or cultural heritage sites with importance for tourism (e.g. abbeys, castles, etc.) and forested areas of particular value. Relatively densely populated areas are also excluded, especially those with dispersed settlement patterns. In contrast, agricultural areas with low population density or fallow land not used for agriculture have proved popular locations for the installation of wind turbines, for example, in Languedoc in the south of France. The way in which wind power was developed and the local context are also differentiating factors. The first wind power projects were relatively modest in size and developed progressively in a series of small phases (e.g. 3 or 4 wind turbines) and were therefore more easily acceptable. More recent projects however often involve the siting of large numbers of big turbines and are more likely to encounter opposition because of their much greater and potentially more harmful impact on the landscape (Fig. 12.2).

Fig. 12.2 Ellern wind farm, installed in the Soonwald Naturpark (Rhineland-Palatinate) in April 2013

12.6.2 Opposition Movements to Wind Turbines

The increase in the size of wind turbines brings a new challenge for their deployment in natural parks. These giant wind turbines (the tallest can be over 150 m high) have an unprecedented impact on the landscape, especially considering they can now be installed in formerly excluded areas such as forests. Large wind turbines are much more likely to arouse public opposition as can be seen in several conflicts that have arisen recently in different parks. Opposition movements to the installation of these new wind turbines have emerged both in parks without wind turbines and in others that already have large numbers. In the first case, for example, in the Soonwald-Nahe Naturpark (Rhineland-Palatinate, Germany), the planned deployment of eight wind turbines in an iconic forest in the park was strongly opposed by many local environmental protection groups. A citizens' initiative[5] was established in February 2009 to prevent the construction of wind turbines by the Juwi company dubbed as 'monstrous' because they had a nacelle height of up to 150 m (Fig. 12.2). This citizens' movement also protested against planned deforestation in Soonwald and its impact on wildlife in the park, warning that the wind farm would bring about the 'destruction of the landscape of Soonwald for decades'. Another group known

[5] http://www.bisoon.de

as the Soonwald Initiative,[6] which has been campaigning since 1993 to have the forest declared a national park, has also taken a stand against the construction of wind turbines.[7] The project to declare Soonwald a national park was put forward amongst other reasons to prevent wind power development. However, as the local authority (Rhein-Hunsrück Kreis) is committed to developing renewable energies in order to become self-sufficient and even an energy exporter, authorization for the installation of the wind turbines has been granted and work clearing the site began in March 2012. Meanwhile, the citizens' initiative tried to mobilize public opinion through a petition, gathering 5,000 signatures in early October 2012.

In September 2012, during a joint press conference entitled 'catastrophe for the landscape',[8] a dozen associations (BUND, NABU, hiking, fishing and hunting associations) protested against the lack of wind power planning in the state of Rhineland-Palatinate. Without calling into question the objectives of the regional government to multiply wind power fivefold by 2020, they recommended that wind turbines be concentrated in certain areas and that biosphere reserves, the central areas of natural parks and other special protection areas for bat and bird life be excluded.

Opposition has also emerged to the installation of wind farms in natural parks that until recently had none, despite these being in parts of the country (northern Germany) with high wind farm densities. One example is the Holsteinische Schweiz park where some small wind turbines have now been installed and where the construction of new large-scale projects has met substantial opposition.[9]

Other opposition movements to wind turbines have appeared in natural parks where they are already present in large numbers. This is the case, for example, in France with the Avants-Monts wind project in the Haut-Languedoc natural park mentioned above or of new wind power projects in the Vogelsberg *Naturpark* in Germany. This park was once the cradle of onshore wind power in Germany and turbines multiplied there unopposed. Now however what most angers the citizens' initiative that sprung up[10] in opposition to new wind power projects is the size of the machines and their proposed location in the centre of the park. Another argument is that there are already large numbers of turbines in the natural park, compared to other parts of Hessen.

12.7 Conclusion

Natural park territories therefore act as something of a barrier to wind power development, particularly because of the value attributed to the landscapes that people wish to preserve, although total prohibition is not normally imposed. In protected

[6] http://www.soonwald.de

[7] http://www.gegenwind-soonwald.de

[8] http://www.naturpark-statt-windpark.de/PM_Katastrophe_fuer_die_Landschaft.pdf

[9] https://sites.google.com/site/hassendorfgegenwind/

[10] http://www.gegenwind-vogelsberg.de

areas in Spain with a high wind energy potential, park management plans often prohibit wind farm development compensating local stakeholders in other ways. In many cases however these planning documents came into force after the wind farms had been installed as happened with the natural parks of Los Alcornocales (Andalusia) and Hoces del Alto Ebro y Rudrón (Castilla y León). In France and Germany, by contrast, natural planning documents do not normally exclude wind power development. In Germany, where wind power development began earlier, some parks have even become high concentration areas. However, these are relatively few in number, and most parks either have no wind turbines or have a relatively limited number, especially compared to surrounding areas.

In France, the only natural parks in which significant wind power development has taken place are those in Languedoc and the southern Massif Central. In the rest of the country, park authorities have preferred to confine the development of wind power to very specific zones, excluding most of their area. In Spain, which proportionally has a much smaller protected area, the main aim of natural parks is landscape and environmental conservation with the result that wind farms and similar large-scale public works are normally prohibited. Future challenges will arise with installation projects involving turbines that are typically much bigger than those built at the beginning of the 2000s. These will almost certainly lead to opposition, even in natural parks, such as the Vogelsberg in Germany, which were once pioneers with the first generation of wind turbines.

References

Afonso AI, Mendes C (2010) Energía eólica y paisajes protegidos: Controversias en el parque natural de montesinho. Nimbus: Revista de climatología, meteorología y paisaje 25–26:5–20

Aitken M (2010) Why we still don't understand the social aspects of wind power: a critique of key assumptions within the literature. Energy Policy 38:1834–1841. doi:10.1016/j.enpol.2009.11.060

Ariza-Montobbio P, Farrell KN (2012) Wind farm siting and protected areas in Catalonia: planning alternatives or reproducing 'one-dimensional thinking'? Sustainability 4:3180–3205. doi:10.3390/su4123180

Benkenstein M, Zielke K, Bastian D-KJ (2003) Wirkungseffekte von Offshore-Windkraftanlagen in Mecklenburg-Vorpommern auf touristische Nachfrage-und Angebotsstrukturen. Ostseeinstitut für Marketing, Verkehr und Tourismus an der Universität Rostock, Endbericht

FORSA (Gesellschaft für Sozialforschung und statistische Analysen mbH) (2007) Umfrage zum Thema Erneuerbare Energien. Berlin

Frolova M (2010) Los paisajes de la energía eólica: Su percepción social y gestión en España. Nimbus: Revista de climatología, meteorología y paisaje 25–26:93–110

Frolova M, Pérez Pérez B (2008) El desarrollo de las energías renovables y el paisaje: algunas bases para la implementación de la Convención Europea del Paisaje en la política energética española. Cuadernos Geográficos de la Universidad de Granada 43:289–309

Günther W (2002) Touristische Effekte von On- und Offshore-Windkraftanlagen in Schleswig-Holstein. Stimmen zur Windenergie: 61–63

GWEC (2013) Global wind report 2012 – annual market update. Global Wind Energy Council: 72. http://www.gwec.net/wp-content/uploads/2012/06/Annual_report_2012_LowRes.pdf

IfR Institut für Regionalmanagement (2012) Besucherbefragung zur Akzeptanz von Windkraftanlagen in der Eifel

IUCN (2008) Guidelines for applying protected area management categories

Johnson GD, Perlik MK, Erickson WP, Strickland MD (2004) Bat activity, composition, and collision mortality at a large wind plant in Minnesota. Wildl Soc Bull 32:1278–1288. doi:10.2193/0091-7648(2004)032[1278:BACACM]2.0.CO;2

Krauss W (2010) The 'Dingpolitik' of wind energy in Northern German landscapes: an ethnographic case study. Landsc Res 35:195–208. doi:10.1080/01426390903557972

Lilley MB, Firestone J (2008) Wind power, wildlife and the migratory bird Treaty Act: a way forward. Environ Law 38:1167–1214

Lilley MB, Firestone J, Kempton W (2010) The effect of wind power installations on coastal tourism. Energies 3:1–22. doi:10.3390/en3010001

Möller B (2006) Changing wind-power landscapes: regional assessment of visual impact on land use and population in Northern Jutland, Denmark. Appl Energy 83:477–494. doi:10.1016/j.apenergy.2005.04.004

Nadaï A (2007) 'Planning', 'siting' and the local acceptance of wind power: some lessons from the French case. Energy Policy 35:2715–2726

Nadaï A, Labussière O (2009) Wind power planning in France (Aveyron): from state regulation to local experimentation. Land Use Policy 3:744–754

Nadaï A, Labussière O (2013) Playing with the line, channelling multiplicity: wind power planning in the Narbonnaise (Aude, France). Environ Plann D: Soc Space 31:116–139. doi:10.1068/d22610

Nadaï A, Van der Horst D (2010) Landscapes of energies. Landsc Res 35:143–155

Nadaï A, Krauss W, Afonso AI et al (2013) Une comparaison de l'émergence de paysages éoliens en France, Allemagne et Portugal. In: Luginbühl Y, Terrasson D (eds) Paysage et Développement Durable. Quae, Paris, pp 157–169

Pasqualetti MJ (2011) Opposing wind energy landscapes: a search for common cause. Ann Assoc Am Geogr 101:907–917. doi:10.1080/00045608.2011.568879

PNR Livradois-Forez (2009) Schéma éolien: Une règle du jeu commune pour les collectivités locales du Parc naturel régional Livradois-Forez

PNR Loire-Anjou-Touraine (2009) Le Parc et l'éolien. Guide pour un développement de l'éolien raisonné et cohérent

Prados MJ, Baraja E, Frolova M, Espejo C (2012) Integración paisajística y territorial de las energías renovables. Ciudad y Territorio XLIV(171):127–143

Ratzbor G (2011) Windenergieanlagen und Landschaftsbild. Zur Auswirkung von Windrädern auf das Landschaftsbild. http://www.dnr.de/downloads/thesenpapier-landschaftsbild.pdf

Selman P (2010) Learning to love the landscapes of carbon-neutrality. Landsc Res 35:157–171. doi:10.1080/01426390903560414

SOKO-Institut Bielefeld GmbH (Institut für Sozialforschung und Kommunikation) (2005) Windkraftanlagen und Tourismus. Bevölkerungsumfrage 2005. Ausgewertete Power-Point-Datei. Eigenstudie ohne Auftraggeber

Troitiño Vinuesa MÁ, de Marcos FJ, García Hernández M et al (2005) Los espacios protegidos en España: significación e incidencia socioterritorial. Boletín de la Asociación de Geógrafos Españoles 39:227–266

Vogel M (2005) Akzeptanz von Windparks in touristischen bedeutsamen Gemeinden der deutschen Nordseeküstenregionen. Das Institut für Maritimen Tourismus der Hochschule Bremerhaven

Weise R, Allendrof M, Koch U (2002) Windenergieanlagen im Landschaftsbild. Analyse einer Bevölkerungsumfrage in Thüringen. Naturschutz und Landschaftsplanung, Zeitschrift für angewandte Ökologie 34:242–246

Wolsink M (2000) Wind power and the NIMBY-myth: institutional capacity and the limited significance of public support. Renew Energy 21:49–64. doi:10.1016/S0960-1481(99)00130-5

Wolsink M (2007) Wind power implementation: the nature of public attitudes: equity and fairness instead of 'backyard motives'. Renew Sust Energ Rev 11:1188–1207. doi:10.1016/j.rser.2005.10.005

Part V
Renewable Energy Landscape Planning Tools and Their Application

Chapter 13
Solar Thermoelectric Power Landscapes in Spain

A New Kind of Renewable Energy Landscape?

Carles de Andrés-Ruiz, Emilio Iranzo-García, and Cayetano Espejo-Marín

Abstract Solar thermoelectric energy has developed in spectacular fashion over the last decade in Spain. The appearance of solar power stations using this technology is changing the landscape in many rural areas, as windfarms and photo-voltaic power stations have done since the end of the 1990s. We begin by presenting the different factors and processes that have facilitated the rapid deployment of this technology. We then go on to make a conceptualization of solar thermoelectric landscapes, by analysing the different kinds of landscape created by these technologies, and we present a map of these new landscapes in Spain. After that, we highlight the tensions and conflicts identified in the different study areas in Spain and analyse the territorial planning processes in relation to this technology. We also propose a series of technical, economic, environmental and landscape criteria that must be taken into account in order to ensure effective territorial planning of solar thermoelectric energy.

Keywords Spanish renewable energy landscape • Solar power landscape • Solar thermoelectric landscape • Environmental conflicts • Landscape and environmental planning

---

C. de Andrés-Ruiz
wpd SAS, 45 rue Turgot, 87000 Limoges, France
e-mail: carles.deandresruiz@laposte.net

E. Iranzo-García (✉)
Facultad de Geografía e Historia, University of Valencia,
Avenida Blasco Ibáñez 28, 46010 Valencia, Spain
e-mail: Emilio.Iranzo-Garcia@uv.es

C. Espejo-Marín
Facultad de Letras, University of Murcia, Campus de la Merced, 30001 Murcia, Spain
e-mail: cespejo@um.es

M. Frolova et al. (eds.), *Renewable Energies and European Landscapes*,
DOI 10.1007/978-94-017-9843-3_13

13.1 Introduction

The appearance of wind turbines and solar power stations in traditional rural landscapes in Spain has brought about one of the greatest changes in the landscape in Spanish history. We could even go so far as to describe it as a 'landscape revolution' (de Andrés Ruiz and Iranzo García 2011). This process has been analysed by various authors, and several studies have been made of the new landscapes produced by wind power and photovoltaic solar energy (Ardillier et al. 2011; Balabanian et al. 2007; Frolova 2010; Mérida Rodríguez et al. 2011). However, very few researchers have so far investigated the landscapes associated with solar thermoelectric energy, one of the fastest growing technologies in Spain in the last five years, which currently produces 2.0 % of the electricity consumed in this country. Solar thermoelectric landscapes are becoming increasingly common in regions with high levels of annual sunshine. The availability of this natural resource and the various legislative initiatives aimed at promoting renewable energies are producing new landscape configurations in territories with a strongly rooted rural economy. But can we really talk about a new kind of landscape, a solar thermoelectric landscape, or is it just a question of the emergence of new industrial elements in rural landscapes?

The main objective of this chapter is to define and geographically locate these potential solar thermoelectric power landscapes. Our research also seeks to pinpoint the reasons behind the development of this technology, to analyse the territorial planning processes and to identify the main conflicts and tensions that have emerged with the development of solar thermoelectric plants, in particular those with a large impact on the landscape. To this end we have analysed the territorial shifts resulting from the installation of various solar thermoelectric power plants in Andalusia, Castilla-La Mancha, Extremadura and the Valencia region.

This chapter is divided into four parts in which we have used different materials and methods.

In the first part, we present the sociopolitical context of this technology, and we discuss the different factors that have led to the appearance of solar thermoelectric energy landscapes: the Spanish regulatory framework, the planning of the development of this technology at a national level and the role of the solar platform in Almeria. This part is based on an analysis of written sources.

In the second part of the chapter, we propose a definition of a solar thermoelectric landscape. We also propose a landscape typology and present a scale map of Spain showing the location of these new landscapes. We drew up the map by combining the landscape typology from the Atlas of the Landscapes of Spain (Mata Olmo and Sanz Herráiz 2004) with information from maps produced by the Spanish Solar Thermoelectric Industry Association (Asociación Española de la Industria Solar Termoeléctrica – Protermosolar) and recent aerial photographs taken for the National Aerial Orthophotography Plan (Plan Nacional de Ortofotografía Aérea, Instituto Geográfico Nacional). In the landscape analysis and the drawing of the map, we used the ArcGIS 9.3 software (a tool for drawing maps and making visual analyses, in this case of power stations), along with in situ observations.

In the third part of the chapter, we combined these methods with qualitative techniques in the form of in-depth interviews with different stakeholders: project developers, local development agents, associations, mayors and other town councillors who have experienced at first hand the installation of a solar thermoelectric power station in their area. These interviews revealed various conflicts and tensions that have arisen in the study areas in relation to the landscape (electricity transmission lines), the use of water and the flora and fauna.

Finally, we analyse the territorial planning processes for solar thermoelectric energy in the study areas. After identifying the weaknesses in this field, we propose a number of criteria, some of which refer to landscape, that should be taken into account when drafting and implementing a territorial plan.

13.2 Key Factors in the Development of Solar Thermoelectric Power in Spain

Various papers on the development of renewable energy in Spain (Frolova 2010; Frolova and Pérez Pérez 2011; Prados et al. 2012) have identified a number of key factors in the expansion of renewable infrastructures in this country, namely, its favourable energy policy and geographical conditions, its vast expanses of farmland, its specific planning regime and financial support systems, the acceptance of renewable energy projects by a majority of the Spanish population and a largely ineffective landscape protection policy. In the specific case of solar thermoelectric power, we should stress the importance of the following key economic and political factors: the introduction of a regulated feed-in tariff and the policy to promote the development of renewable energies. The Almeria Solar Platform also played an important role in terms of the research and development of solar thermoelectric technology in Spain.

From 1999 to 2013, different Spanish governments established a very favourable policy framework for renewable energies. During this period, three national plans on renewable energy were approved. The Plan for the Development of Renewable Energies 2000–2010, approved by the Council of Ministers on 30 December 1999, set targets for the development of each of the different renewable energy sources and a joint target such that at least 12 % of the primary energy consumed in Spain in the year 2010 should come from renewable sources. In July 2005, the Spanish government approved the Plan for Renewable Energies in Spain 2005–2010, which revised and replaced the Plan for the Development of Renewable Energies 2000–2010. The target production for solar thermoelectric energy of 500 MW was distributed around the regions with the highest solar radiation in Spain: Andalusia (300 MW), Castilla y León (50 MW), Castilla-La Mancha (50 MW), Extremadura (50 MW) and Murcia (50 MW). Yearly targets were also set for the following production levels to come on stream: 10 MW in 2006, 40 MW in 2007, 40 MW in 2008, 150 MW in 2009 and 150 MW in 2010. In November 2011, the Council of Ministers of the Spanish government passed the ‘Energy Planning Initiative’ and ‘The

Renewable Energies Plan 2011–2020'. The aim of these various measures was that by the year 2020, at least 20 % of the final gross energy consumption in Spain should come from renewable sources. The target for solar thermoelectric power was for an installed capacity of 4,800 MW in 2020, up from 632 MW installed at the end of 2010, an increase of 4,168 MW.

The various economic incentives established between 1997 and 2013 created excellent economic conditions for the development of solar thermoelectric power. Law 54/1997 on the electricity sector laid down the principles for a new model of electricity production based on free competition, compatible with an improvement in energy efficiency, the reduction of consumption and the protection of the environment. To this end it set up a special regime for electricity production, using installations powered by renewable resources or sources, waste products and cogeneration, with a maximum power production of 50 megawatts (MW). Between 1997 and 2013, four different Royal Decrees (RD) (RD 2818/1998, RD 841/2002, RD 436/2004, RD 661/2007) established regulated feed-in tariffs for solar thermoelectric electricity. In the first period, from 1997 to 2007, the price was set at around 0.15 euros (€) per kilowatt hour (kWh). This was increased in the second period from 2007 to 2013, to a minimum price of around 0.25 €/kWh and a maximum of about 0.35 €/kWh, both figures considerably higher than the market price for electricity. This situation changed dramatically at the beginning of February 2013 with Royal Decree 2/2013, which eliminated the reference premium and the maximum and minimum values.

All these circumstances enabled Spain to become one of the pioneers in the research and development of solar thermoelectric energy at a world level. The first and the best equipped facility in the world for testing concentrated solar radiation applications was the Almería Solar Platform (PSA). This project first appeared at the end of the 1970s as a result of an initiative of the International Energy Agency (IEA). At the same time, the Spanish government decided to embark on another project on the same site in which only Spanish companies took part. This led to the construction of the Almería Solar Electric Power Plant (CESA 1). The most significant consequence of the research and development work on these two projects (IEA and CESA 1) was the experimental certifiable proof of the technical feasibility of generating electricity using direct solar radiation, the original objective of the project. The Almeria Solar Platform has also provided a valuable service in testing the technologies and components currently being manufactured for use in Spanish solar thermoelectric power plants. This has provided an important boost to the development of this technology in this country.

13.3 The New Solar Thermoelectric Landscapes: Definition, Typology and Geographic Location

In this favourable sociopolitical context, new types of energy infrastructure have been spreading across Spain fast. They are modifying landscapes and landscape practices in this country in such a way the landscapes they produce can be distinguished from other landscapes. But do they actually define the character of the emerging landscapes? Can we refer to them as a new type of landscape, namely, solar energy landscapes or helio-landscapes? In the next section, we define what we mean by solar thermoelectric landscapes and analyse their main characteristics. We then present a map showing the geographic location of these new landscapes and their typology in Spain.

The European Landscape Convention defines landscape as ‘any part of territory as perceived by people, whose character is the result of the action and interaction of natural and/or human factors’. This definition reflects both the material and the immaterial character of any landscape, because territory becomes landscape only through the process of its perception. The production and management of energy have been changing the character of some Spanish landscapes, the social practices related with them (Frolova and Pérez Pérez 2008) and their perception. The emergence of solar thermoelectric landscapes and their subsequent configuration is the result of an interaction between environmental factors and human action. A solar thermoelectric landscape can thus be defined as the manifestation of new industrial processes in the landscape as viewed, filtered and interpreted by its observers or, in other words, a space in which solar thermoelectric power is produced as perceived by its observers.

Solar thermoelectric infrastructures impose an industrial character on any landscape, particularly when installed in a relatively small, self-contained area. However, they are often inserted into much larger territories covering many square kilometres. In this case the landscapes they produce are of a mixed nature, combining the industrial character of the power plant with traditional primary-sector land uses (mostly, agriculture and forestry). These landscapes could therefore be considered as ‘agro-industrial’ or ‘silvi-industrial’ landscapes: a mixed landscape created by inserting into the dominant agricultural or agriculture/forestry context artificial elements and complementary infrastructures that have nothing to do with the natural or agricultural/forestry system. Some authors that specialise in territorial planning and renewable energies have defined these landscapes as energy landscapes (Ardillier et al. 2011; Balabanian et al. 2007; Espejo Marín 2010) and more recently as helio-landscapes (de Andrés Ruiz and Iranzo García 2011), although it is true that this latter definition encompasses both solar thermoelectric and solar photovoltaic landscapes.

13.3.1 Characteristics of Solar Thermoelectric Landscapes

Solar thermoelectric landscapes are visually characterised by an extensive occupation of land, by the horizontal nature of the installation and by its geometric layout; by the dazzle effect from the mirrors and the reflections from the metal structures; by the tall vertical nature of the tower in some cases or the power island[1] in others;

[1] Area in a solar thermoelectric power plant where the heat from the field of mirrors is concentrated. This is also the site of the turbines and generators.

by the columns of steam released into the atmosphere and finally by the need to be close to transmission lines, which in themselves have a high visual impact on the landscape. Solar thermoelectric power plants often compete directly with other uses of both land and water such as agriculture, silviculture, etc. In addition, the particular characteristics of these power plants make shared use of the land in which they are installed impossible with the result that arable and grazing land and sometimes forests are replaced by 'fields of mirrors'.

Thermoelectric power stations need a large area of land and a plentiful supply of water. The visual structure of these power plants varies according to the technology used to generate the electricity. The type of materials, the water consumption, the infrastructure and the shape and size of the installation all vary from one system to another.

Concentrated solar power (CSP) systems use a large array of mirrors and/or lenses to concentrate the sun's energy onto a focal point. In this way they transform the direct components of solar radiation into heat energy at high temperature. This heat energy is then converted into electricity for immediate use and in some cases into energy that can be stored in the form of heat or in chemical form, in all these cases by means of solar concentrators made up of mirrors or lenses (Silva Pérez and Ruiz Hernández 2010).

There are currently four types of thermosolar technology of particular note because of their high degree of technological development (Espejo Marín and García Marín 2010): parabolic troughs, solar power towers, linear Fresnel concentrators and Stirling parabolic dishes (Fig. 13.1). Each of these technologies has certain specific characteristics that help create different kinds of solar thermoelectric landscapes, although all these landscapes have a set of common features.

The term 'parabolic troughs' refers to the shape of the mirrors used to collect the sunlight. These mirrors are mounted on solar trackers and are positioned in such a way that the sunlight they reflect is concentrated onto high heat-efficiency tubes located on the focal line of the troughs. These tubes, which are filled with a synthetic oil fluid, absorb the solar radiation, which heats the fluid up to temperatures of around 400 °C. The fluid is then pumped through a series of heat exchangers to produce overheated steam. The heat in the steam is converted into electricity in a conventional steam turbine.

The parabolic trough plants have a very geometric layout due to the fact that the solar field is square and the mirror units for catching the solar radiation are arranged in straight lines. They normally occupy a large swath of land as around 3 ha of mirrors are required to produce each megawatt of installed electrical power. In many cases, the structures in the solar field are around 5 m high, which means that its horizontal dimensions and its straight lines dominate over its vertical impact. The only important vertical element is the power island both because of the dimensions of its various installations and because of the water vapour released into the atmosphere from the cooling tower.

The aforementioned overall horizontal nature of parabolic trough thermoelectric plants means that their visual impact on the landscape can be minimised using slopes and plant screens and, above all, with the distance factor. According to

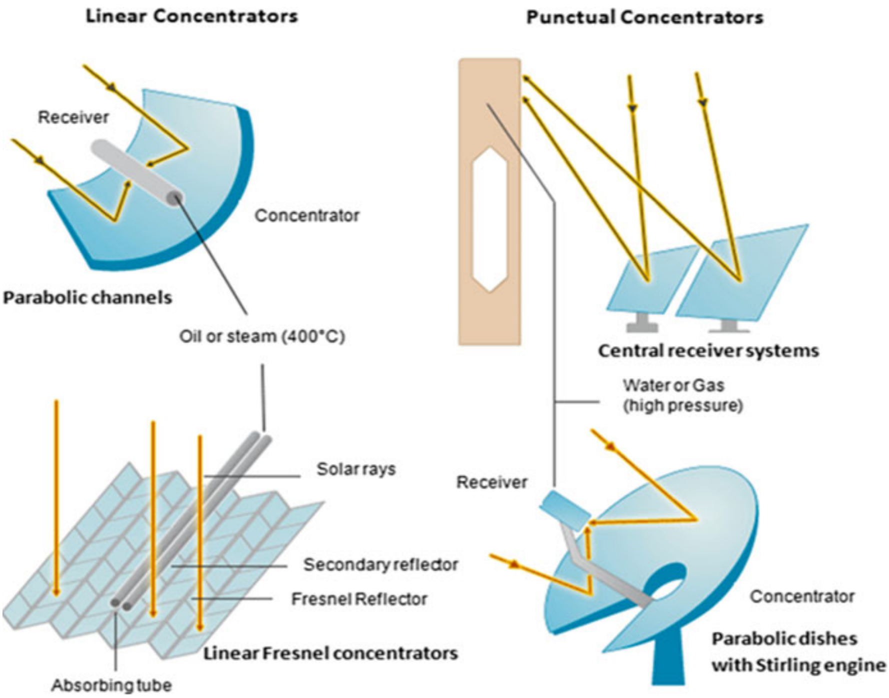

Fig. 13.1 Solar thermal technologies for electricity generation (Source: http://abengoasolar.com)

Mooney et al. (2006), the visual impact of a parabolic trough plant is minimal at a distance over 100 m given that the height of this extensive field of mirrors is rarely greater than 5 m. This could be true in the case of a solar plant situated in a large plain with a minimum incline, but our fieldwork shows that in fact, the visual impact affects much larger distances.

In the landscapes created by linear Fresnel concentrators, the horizontal nature of these installations and their straight lines are much more important than their vertical dimension, although in this case the receivers are more than 8 m above the ground. A linear Fresnel concentrator plant typically consists of long (100 m), flat, narrow (0.4 m) sections of mirror situated on a horizontal plane which rotate around their main axis, tracking the sun and focusing its radiation on a fixed receiver situated 9 m above the mirrors. The linear concentrator is like a parabolic cylindrical concentrator extended across a flat surface. The slats are made up of almost flat mirrors (they are slightly curved) on top of a rotating support structure. Each of these structures is moved by a small stepper motor. The main differences between these mirrors and those used in the parabolic trough plants are that they are straight, rather than curved, they are installed a metre above ground and the absorption tube (receiver) and a secondary mirror are positioned above them. One advantage of these plants is that they normally take up less space than parabolic trough plants as the lines of mirrors can be closer together. This reduces their impact on the landscape in that the same amount of power can be produced in a smaller area.

The Stirling parabolic dish plants use a different technology, which in turn has a different effect on the landscape. This technology is based on the concentration of the solar radiation hitting a parabolic dish on a receiver positioned at its focal point. The Stirling engine has two cylinders, one in the cold source and the other in the hot one, joined together by a pipe. The working gas is driven between the hot cylinder (the one that receives the radiation) and the cold cylinder by a set of pistons and rods connected to a shared flywheel. This engine has a low energy density, which means that it reaches relatively low power levels of up to 100 kW for an 8 m diameter dish (Caño 2009). So far, the solar concentrators are not installed in continuous lines and instead sit some distance apart from each other. As a result, they take up more space. The structures themselves are also larger. The dish-shaped concentrator has quite a prominent shape and dimensions with a diameter of around 8 m. These plants require 4.5 ha of land for each megawatt of installed capacity, considerably more than that required by the parabolic trough system (García Garrido 2012).

Finally, in solar power towers, a field of heliostats (mobile mirrors) tracks the position of the sun and reflects the radiation to concentrate it up to 600 times on a receiver situated at the top of a tower around 100 m tall. This heat is transferred to a fluid in order to produce steam, which expands inside a turbine coupled to a generator and so produces electricity. These tower (or central receiver) plants create a different landscape from the previous systems. Due to the technical characteristics of the installation, the field of mirrors is laid out in a circle or oval shape, which makes them easily distinguishable from the square fields used in parabolic trough plants; the most striking feature of this installation is the central tower, which dominates the scene at around 100 m high. This type of plant therefore has the greatest visual impact on the landscape because the tower is visible from a much greater distance in the open spaces and gentle reliefs in which they are normally installed.

Most of the solar thermoelectric power plants in Spain that are currently in use, in construction or approved use the parabolic trough technology. Of the 55 existing plants, 48 use this technology, while the remaining seven use Fresnel parabolic dish or power tower systems.

These are the different technologies used for electricity production in solar thermoelectric power plants. These technologies create energy landscapes in the same way as similar technology such as photovoltaic energy. Therefore, solar thermoelectric landscapes and photovoltaic solar landscapes each constitute a subtype of a more generic type of landscape that we refer to as a solar energy landscape or helio-landscape.

However, are these technologies the only factors determining the character of these landscapes? In our opinion, their character does not depend so much on the type of technology used as on whether or not the plant is installed in a self-contained geographical area, whether there is a succession of closely sited plants or whether it contributes to create a collective image. In order to define the different configurations of helio-landscapes, three factors must be taken into consideration: the topographic characteristics of the area in which the plant is installed, the concentration factor and public perception.

The configuration of the land creates either open or closed landscapes; in this case, if the plant is located in a visual enclosure (a self-contained geographical area), this would make the character of the landscape almost entirely dependent on the solar thermoelectric installation, and the visual structure of the area would enhance the visibility of the plant. However, if a single plant is installed in an area with gently sloping topography, an open visual structure and a predominantly agricultural setting, this softens the impact of the installation. The concentration factor must also be taken into consideration. Sometimes, a number of different solar plants (both thermoelectric and photovoltaic) are installed adjacent or close to each other, in order to obtain economies of scale (e.g. by using shared power transmission lines). This creates a solar energy landscape or helio-landscape, a geographical area in which although there may be various other human activities, it is solar energy production that bestows on the landscape its particular character. Finally, public perception of electricity production plants and transmission line networks also affects the character of the landscape. Public perception depends on the symbolism of the affected landscape and the balance between the benefits and the negative effects of these facilities.

A helio-landscape, which includes solar thermoelectric landscapes, could therefore be considered as a complex multifunctional landscape in which the morphological characteristics, the concentration of solar plants and their social perception allow energy production to prevail over other land uses. An accurate assessment of helio-landscapes is essential for the implementation of spatial planning instruments.

13.3.2 Location and Typological Classification of Spanish Solar Thermoelectric Landscapes

Solar thermoelectric power landscapes are becoming increasingly frequent in certain parts of Spain. At the end of 2012, Spain had 43 thermoelectric plants in operation, 8 under construction and 4 with government approval (Fig. 13.2). Of the 55 plants, 54 were located in southern Spain, the part of the mainland with the highest solar radiation values. The plants connected to the grid had an installed capacity of 1,954 MW and covered an area of 6,863 ha.

The procedure we followed for identifying and mapping solar thermoelectric landscapes was based on compliance with at least one of these three criteria: the concentration factor or proximity between plants, plant intervisibility and the surrounding topography. After locating the installations, we made a visual analysis of them using a GIS. For this purpose, we calculated the viewsheds for each power plant, taking into account the vertical dimensions of each plant, which varied according to the type of technology used. In this analysis we considered the plants currently in operation, those in construction and those that have been approved by the relevant authorities.

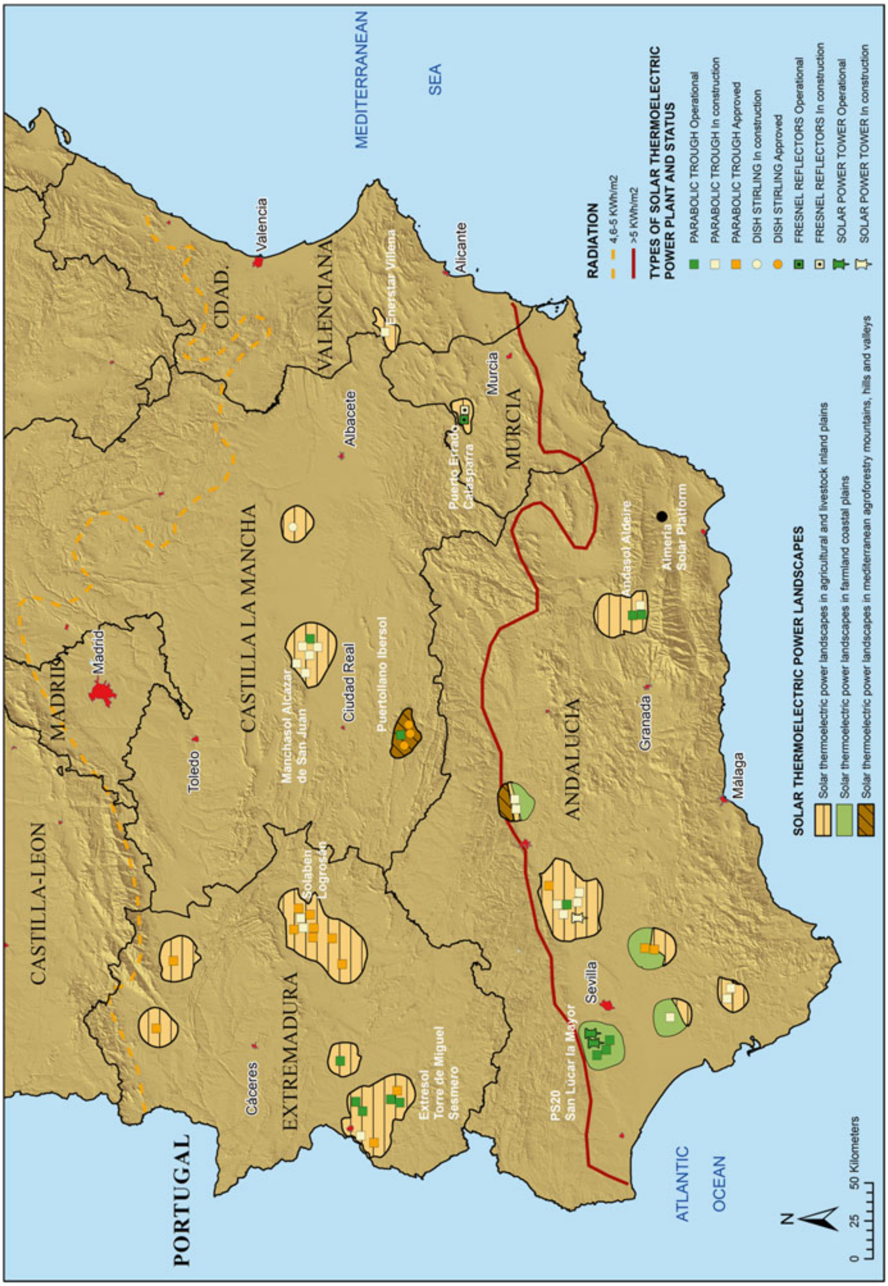

Fig. 13.2 Location of solar thermal power plants. 2012 (Source: Asociación de Empresas de Energías Renovables)

In geographic terms the helio-landscapes are located in the southern half of Spain, an area within which there are three specific sectors, situated below the 40 parallel north, in which these landscapes are becoming increasingly common: the Guadalquivir Valley, with an installed capacity of 400 MW in the province of Seville, 300 MW in the province of Cordoba and 100 MW in the province of Cadiz; the plains of Extremadura, with 450 MW in the province of Badajoz and 150 MW in the province of Cáceres; and Castilla-La Mancha, with 350 MW in the province of Ciudad Real. In these sectors, as indicated on the map (Fig. 13.2), the direct solar radiation is very high due to a lack of cloud cover during most of the year, a fact that confirms the excellent potential of solar energy in these locations.

We also classified the different types of solar thermoelectric landscape on the basis of the landscape typology proposed in the Atlas of the Landscapes of Spain (Mata Olmo and Sanz Herráiz 2004). To this end we condensed the different associations of types of landscape defined in the Atlas into 12 landscape fields. In order to be able to mark out the position of the landscapes on the map, we used a GIS combining the solar thermoelectric landscapes with the landscape areas identified in the Atlas.

Using this procedure, we produced a map showing the distribution of solar energy landscapes (a subtype of energy landscapes) in Spain, detailing the technology used, the activities for which the land was used previously or neighbouring activities, the geomorphology and the geographical location. Spanish solar thermoelectric landscapes are essentially agricultural or livestock-farming helio-landscapes on inland plains and *campiñas*[2] and agricultural helio-landscapes on coastal plains (Fig. 13.2).

13.4 Development of Solar Thermoelectric Energy: Conflicts and Tensions

Although in most cases, there is no organised opposition to solar thermoelectric power plants, the emergence of this new landscape has not been free of conflicts and tensions. In our research, we have identified three main sources of conflict:

- The landscape impacts of the transmission line network
- The use of water
- The impacts on flora and fauna

In many cases, these conflicts and tensions appeared during the ‘public consultation period’. In the Spanish administrative procedure, this is a necessary step organised by regional authorities. Before receiving official authorisation to build a solar thermoelectric power plant, project developers must present an environmental impact assessment to the regional administration. The full project and the report containing this assessment must be on display to the public during this consultation

[2] Hilly agricultural area with cereals or olive groves

period. This does not mean, however, that local residents are involved in the decision-making process on solar thermoelectric power projects (Frolova 2010; Frolova and Pérez Pérez 2011).

13.4.1 Conflicts and Tensions Arising from the Landscape Impact of the Transmission Line Network

In some solar energy projects, the construction of new high-voltage electricity transmission lines (110–225 kV) has been opposed by conservationist groups and local residents. In the case of the solar thermoelectric plant in Villena in the Valencia Region, the main conflict we identified was in relation to the transmission lines. The power plant was 21 km away from the nearest point of connection to the grid, and a new high-voltage transmission line had to be installed to connect it. It is interesting that during the public consultation period when the project was on display to the public, the solar plant received only about a dozen complaints, while the transmission line received 1,800 protests from green associations and residents of the towns affected, who opposed the construction of this line on landscape and health grounds. The project developer had to reply to these protests. They also had to reach agreements with the parties involved in the conflict. The project was finally erected in 2013, but the development process was considerably delayed by this landscape conflict.

13.4.2 Conflicts About Water Use

As we have seen before, solar thermoelectric power plants consume large amounts of water and are normally situated in semiarid areas of the southern half of the Iberian Peninsula, in which water is a scarce resource that is essential for other activities such as agriculture and tourism. In some projects such as those by Andasol in the village of Cortes de Baza in Granada, Andalusia, the development of solar thermoelectric plants led to conflicts over the use of water. In this case, there was a dispute between Cortes de Baza and its neighbouring villages over a plan to transfer water from Cortes de Baza in order to guarantee domestic water supply to its neighbours, a plan which Cortes de Baza opposed. When these neighbouring villages discovered that there were plans to build four solar thermoelectric plants in Cortes de Baza and that these would consume large amounts of water, their protests multiplied as they considered domestic water supply to be a higher priority use of this scarce resource than energy production. As of November 2014, this project has yet to be executed, mainly for economic reasons, but this conflict about water had also a significant influence on the development process.

However, the case of Cortes de Baza is something of an exception as in general there have been few conflicts relating to the use of water as a result of the installation of solar thermoelectric plants. This is due, firstly, to the fact that the potential parties to the conflict, normally the power plant developers and the farmers that need to water their crops, have usually reached agreements; secondly, due to the fact that the relatively small number of plants does not consume large quantities of water in comparison with regional or national consumption; and, thirdly, because power plants are normally installed on agricultural land that would otherwise be irrigated, so offsetting the water consumed by the power plant. A good example of this is the Manchasol and Aste solar power plants in Alcázar de San Juan in Castilla-La Mancha, where the water previously consumed for agriculture (irrigated cornfields) on the current site of the power plants has dropped from 10,000 m^3 per Ha per year to the 5,000 m^3 per Ha per year currently consumed by the solar power stations (Plaza Tabasco 2011).

13.4.3 Conflicts Arising from the Impacts on Flora and Fauna

The space occupied by a solar thermoelectric power station can have a significant effect on local fauna and flora. For birds, for example, the transformation of an agricultural space into a solar thermoelectric plant leads to a loss of habitat, which will be of greater or lesser importance depending on the location of the site. The electricity transmission lines may also have a significant impact. In the case of the thermoelectric power stations in Navalvillar de Pela in Extremadura, there was strong opposition from ecological groups such as SEO/BirdLife. According to this association, the location of the power plants in an area of special protection for birds (SPA) and therefore part of the European Natura 2000 network would have a very serious impact on birds such as cranes that roost there (Espejo Marín and García Marín 2010). During the public consultation period when the project was on display to the public, there were several protests concerning birdlife, in response to which various changes were made to the project. The power plants were finally erected in 2013, but the protests of this conservationist group considerably delayed their construction.

13.5 Territorial Planning of Solar Thermoelectric Energy

In spite of the fact that most project developers have selected sites that appear to be suitable, the absence of specific territorial planning policy has been a key factor in the various conflicts and tensions we observed, bearing in mind also that public participation was limited to the official period of public consultation.

For some renewable energies such as wind power, different territorial plans have been drawn up in Spain to define the areas in which this energy source can or cannot be installed, although most of these plans did not take landscape criteria into account. In the case of solar thermoelectric energy, however, none of the regions we analysed have made recommendations as to the best sites for solar thermoelectric plants according to technical, environmental or landscape criteria. The search for suitable sites is performed directly by the project developers.

During our field studies, we established several criteria that should be taken into account to ensure correct territorial planning for this energy system. Of these the most important are, on the one hand, a plentiful supply of solar radiation, water availability and proximity to an electricity grid with sufficient capacity and to a high-quality transport network and, on the other hand, a number of landscape factors: a preferred location on gentle, south-facing slopes and open plains, in agricultural landscapes with low yield (cereals, forage, etc.) and in places of little interest for fauna and flora or for natural and cultural heritage.

13.5.1 A Plentiful Supply of Solar Radiation

The overall solar radiation is the amount of energy reaching a particular point during the course of one year and is normally measured in kW/h/m^2. The overall radiation is the sum of the direct radiation (radiation of greater than 120 W/m^2 capable of casting shadows) and diffuse radiation (less than 120 W/m^2). The different solar thermoelectric technologies can only generate energy from direct radiation.

In Spain for a variety of technical and economic reasons, only the sites which have an annual direct radiation of more than 1,800 kW/h/m^2 a year can be used. The installation of power stations in areas with lower levels of solar radiation would lead on the one hand to much higher electricity production costs and on the other to a higher environmental and landscape impact because a larger surface area would be required to produce the same amount of electricity.

13.5.2 Availability of Water

Potential sites for solar thermoelectric power plants must have at least 5,000 m^3/year of water per hectare covered by the plant, which cannot be shared with other water-consuming activities such as agriculture and tourism. It is therefore essential for the site to be close to a reservoir or aquifers that can guarantee this level of water supply. In general, to reduce water consumption as far as possible, artificial ponds should be constructed in order to capture, store and reuse rainwater and run-off from the plant or its surrounding area.

13.5.3 Proximity to the Grid

Solar thermoelectric plants must be as close as possible to points of connection with the national grid with sufficient transmission capacity. Distances of less than 5 km are recommended. In this way, one of the greatest impacts on the landscape of this kind of project (transmission lines) is reduced, and investment costs are minimised. Another possibility would be to concentrate several power plants of this kind in the same area with a large electricity transmission capacity, thereby enabling several plants to use a single transmission line.

13.5.4 Proximity to a High-Quality Transport Network

The different components of the solar power plants such as mirrors, solar tracking systems, collector tubes, etc., must be transported by road from the factory to the installation site. The railway network may also play an important role in the transport of large items such as the turbines or generators for the plant. The presence of a nearby, high-quality transport network is therefore an essential factor when assessing the technical and economic feasibility of a particular site/installation. The proximity of this transport network may have important consequences for the landscape in that it could lead to a considerable increase in the number of 'spectators' that stop to look at the landscape. As far as is possible, solar thermoelectric plants should be difficult to see from this transport network.

13.5.5 Gentle, South-Facing Topography and Plains

Solar thermoelectric plants must be installed on sites with a gentle incline (in general less than 3 %) facing south. Installation on sites with a steeper incline would require much higher initial investments and would create a more significant impact on the landscape in the area near the power plant.

In addition, these infrastructures should be situated on large, open plains, in which the plants with parabolic cylinders, just a few metres high, fade into the horizon at relatively short distances. The limited visual impact they cause could be reduced or eliminated by landscape features (trees, buildings) or different landscape protection measures, such as the construction of artificial hillocks. If, on the contrary, the power plants were installed in mountain areas, they would be much more visible and at much greater distances of up to 20 km.

13.5.6 Low Agricultural Yield

Solar thermoelectric plants are best installed on land with low agricultural yield in which cereals, forage or similar crops are grown or on land typically used for extensive livestock grazing. In this way we can preserve the best agricultural land for future generations and at the same time ensure lower investment costs for power plant developers in that this type of land is normally cheaper.

13.5.7 Places of Little Interest for Fauna and Flora

Solar thermoelectric plants should not, for example, be situated in areas belonging to the European Natura 2000 network (SCIs and SPAs). In this way we can preserve spaces that are of interest for their biodiversity and/or landscape.

13.5.8 Places of Little Cultural and Archaeological Interest

Solar thermoelectric plants must be located in places of little cultural or archaeological interest. They should not be sited in places with cultural heritage of regional importance (protected historical monuments, water heritage, old towns of historical or artistic interest, etc.), and there should be a minimum of 500 m between these landscape features and the power plants. The main archaeological sites in the region must also be considered off-limits.

13.6 Conclusions

Solar thermoelectric landscapes have been emerging in different parts of Spain in recent years. They are concentrated in the southern half of the Iberian Peninsula, especially in three specific areas of the Guadalquivir Valley and the plains of Castilla-La Mancha and Extremadura. Although they have some similar characteristics to the landscapes created by solar photovoltaic (PV) power, it would seem more accurate to talk about solar energy landscapes or helio-landscapes as an umbrella term covering these different technologies, as they also have a number of specific features that distinguish them from solar PV power. These features and in particular the specific requirements of solar thermoelectric energy (water availability, extensive occupation of land, its visual impact, etc.) sometimes give rise to a variety of tensions and conflicts. Although the development of solar thermoelectric energy has met with generalised local support, some conflicts have emerged in relation to the landscape, water consumption and the protection of biodiversity. The absence of specific territorial planning policy has been a key factor in these conflicts. The main lesson to be learnt from this early stage of solar thermoelectric energy development in Spain is the need to implement territorial planning policies specific to this technology and to establish administrative procedures that include a real process of social participation in which local stakeholders are actively involved in the decision-making process. In this way these new landscapes can develop into genuinely multifunctional spaces, and the provisions of the European Landscape Convention regarding the inclusion in the planning process of the visions of different stakeholders can be implemented.

Finally, in order to ensure the harmonious development of solar thermoelectric power in the future, further advances must be made in the analysis of the territorial and landscape criteria for the installation of solar power plants. By introducing landscape criteria into our planning procedures, we can give an additional territorial and landscape dimension to solar thermoelectric power deployment.

References

Ardillier F, Balabanian O, de Andrés Ruiz C (2011) Los nuevos paisajes energéticos de España. In: Humbert A, Molinero Hernando F, Valenzuela Rubio M (eds) España en la Unión Europea. Un cuarto de siglo de mutaciones territoriales, 1st edn. Casa de Velázquez, Madrid, pp 41–58

Balabanian O, Ardillier F, de Andrés Ruiz C (2007) L'énergie éolienne dans les espaces ruraux fragiles français et espagnols. In: Barthe L, Cavaille F, Eychenne C, Pilleboue J (eds) Habiter et vivre dans les campagnes de faible densité, 1st edn. Ceramac, Clermont Ferrand, pp 365–378

Caño A (2009) Tecnologías de transformación solar-eléctrica. Appa Info 29:22–23

de Andrés Ruiz C, Iranzo García E (2011) Desarrollo de las energías renovables y cambios paisajísticos: propuesta de tipología y localización geográfica de los paisajes energéticos de España. In: Energía y Territorio: dinámicas y procesos. Asociación de Geógrafos Españoles y Universidad de Alicante, Alicante, pp 97–108

Espejo Marín C (2010) Los nuevos paisajes de la energía solar: las centrales termosolares. Nimbus 25–26:65–91

Espejo Marín C, García Marín R (2010) La Energía solar termoeléctrica en España. Anales de Geografía 30:81–105

Frolova M (2010) Los paisajes de la energía eólica: su percepción social y gestión en España. Nimbus 25–26:93–110

Frolova M, Pérez Pérez B (2008) El desarrollo de las energías renovables y el paisaje: algunas bases para la implementación. De la convención europea del paisaje en la política energética española. Cuadernos Geográficos de la Universidad de Granada 43:289–309

Frolova M, Pérez Pérez B (2011) New landscape concerns in the development of renewable energy. Projects in South-West Spain. In: Roca Z, Claval P, Agnew J (eds) Landscapes, identities, and development. Ashgate, Farnham, pp 389–401

García Garrido S (2012) Principios de funcionamiento de las centrales solares termoeléctricas. In: FENERCOM (ed) Guía técnica de la energía Solar Termoeléctrica. Dirección General de Industria, Energía y Minas de la Comunidad de Madrid, Madrid, p 317

Mata Olmo R, Sanz Herráiz C (eds) (2004) Atlas de los Paisajes de España. Ministerio de Medio Ambiente, Madrid

Mérida Rodríguez M, Lobón Martín R, Perles Roselló MJ, Reyes Corredera S (2011) El emplazamiento de las plantas fotovoltaicas y sus repercusiones paisajísticas. In: Energía y Territorio: dinámicas y procesos. Asociación de Geógrafos Españoles & Universidad de Alicante, Alicante, pp 239–250

Mooney D, Mehos M, Blair N, Christensen C, Janzou S, Gilman P (2006) Solar Advisor Model (SAM) overview. In: Sopori BL (ed) 16th workshop on crystalline silicon solar cells and modules: materials and processes. Extended abstracts and papers. Proceedings of the workshop held 6–9 August 2006. National Renewable Energy Laboratory, Denver, p 23

Plaza Tabasco J (2011) El desarrollo de la energía termosolar en La Mancha: innovación territorial, diversificación económica, gestión del agua y sostenibilidad. In: Energía y Territorio: dinámicas y procesos. Asociación de Geógrafos Españoles & Universidad de Alicante, Alicante, pp 387–397

Prados MJ, Baraja E, Frolova M, Espejo C (2012) Integración paisajística y territorial de las energías renovables. Ciudad y Territorio XLIV(171):127–143

Silva Pérez M, Ruiz Hernández V (2010) Las tecnologías solares de generación de electricidad. In: La electricidad termosolar. Historia de un éxito de la investigación. Asociación Española de la Industria Solar Termoeléctrica, Sevilla, pp 399–439

Chapter 14
The Production of Solar Photovoltaic Power and Its Landscape Dimension

The Case of Andalusia (Spain)

Matías Mérida-Rodríguez, Rafael Lobón-Martín, and María-Jesús Perles-Roselló

Abstract Solar photovoltaic power development has had various effects on the landscape, especially in rural areas, where the contrasts with other land uses are more striking. Landscape criteria are not normally taken into account in the planning and the design of these installations, and measures must therefore be taken to control and manage photovoltaic development in order to ensure that the quality of the landscape is preserved or even improved. In this case, one of the most effective landscape management tool is the integration of these installations into the landscape. In this chapter, we analyse the landscape features of these installations, and systematize their impacts on the landscape. We also offer various landscape integration proposals, as a kind of Good Practice Guide. Our case study focuses on the Andalusia region of southern Spain, where there has been very rapid development of photovoltaic power energy in recent years. We believe this is a representative case and that the results can be extrapolated to other areas in which a similar process is taking place.

Keywords Renewable energies landscapes • Solar photovoltaic plants • Landscape integration • Landscape impact • Andalusia

M. Mérida-Rodríguez (✉) • M.-J. Perles-Roselló
Departamento de Geografía, Facultad de Filosofía y Letras, Universidad de Málaga, Campus de Teatinos, s/n. 29071, Málaga, Spain
e-mail: mmerida@uma.es; mjperles@uma.es

R. Lobón-Martín
LDV Arquitectura y Paisaje S.L., Avenida España nº 3B, 29680 Estepona, Málaga, Spain
e-mail: rlm@coamalaga.es

M. Frolova et al. (eds.), *Renewable Energies and European Landscapes*,
DOI 10.1007/978-94-017-9843-3_14

14.1 Introduction

Solar photovoltaic energy installations and, in particular, photovoltaic power plants have grown so quickly in Spain that it has been very difficult to assess their impact on the landscape, especially in regions such as Andalusia, in which development has not been restricted by climatic or legislative limitations (de la Hoz et al. 2013). This development is often at odds with the quality of landscapes and has frequently resulted in important impacts, due to the lack of landscape and territorial planning considerations during this expansion process. The deployment of photovoltaic energy plants has taken place above all in rural locations outside protected areas, in ordinary landscapes used by local people on an everyday basis. It is therefore necessary to strike a balance between photovoltaic power and landscape, by applying measures that combine the development of environmentally friendly sources of energy and the defence of the landscape values of the territory. Landscape integration, as an instrument of landscape management, offers an effective means of diminishing the negative effects of these new installations and promoting their scenic potential.

Within this context, the main goal of this chapter is to explore the existing connection between photovoltaic power plants and landscape, analysing the perceptible dimension of these installations and their effects on the landscape. In this way we will be establishing a series of landscape integration guidelines which together form a Good Practice Guide, as to the best way to incorporate these elements into the landscape, in order to maintain or improve its quality. We use the definition of landscape set out in the European Landscape Convention, namely, any part of the territory, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors (Council of Europe 2000). In this sense, this chapter seeks to analyse the factors and elements that affect our perception of photovoltaic plants, systematising the modifications they make to the landscape and its character. We also analyse public perception and evaluations regarding these plants and propose ways to advance in the landscape integration of these new components of landscape. In the methodology we propose there are five variables: location and site of the installations, density, overall design, design of the component parts and internal organisation of these components. These variables in turn give rise to three methodological phases: identification of the landscape features of photovoltaic plants, analysis of their impacts and proposals for landscape integration.

As a case study, we will be analysing the region of Andalusia (Spain). In this region, the proliferation of photovoltaic plants has been particularly intensive during the first decade of this century and has affected a wide variety of landscapes. It is, therefore, a representative case study for the analysis of this issue, and the results can be extrapolated to other areas in which a similar process is taking place. The information used in this chapter is the result of a detailed analysis of the existing photovoltaic plants in Andalusia in 2009 – a total of 88 installations – and of the assessment of their effects on the landscape, as gauged by the research team and by the results of a survey of the nearby population.

This chapter has been structured into four sections. In the first section, we examine the energy potential of Andalusia and the development of photovoltaic power in the region so far. In the second part, we explore the landscape characteristics of Andalusian photovoltaic plants, and in the third we classify the impacts of these installations on the landscape. Finally, the last part seeks to identify the best landscape integration measures to ensure that the plants blend in as much as possible with their surrounding landscape.

14.2 Theoretical Background

The study of the relationships between photovoltaic power and the environment is a recent area of research, and its landscape dimension has hardly been tackled. Most research in this field has focused on the environmental repercussions of photovoltaic energy. One of the first studies of the environmental impact of solar technologies, including photovoltaic energy, was by Tsousos et al. (2005). Many others such as Aguado-Monsonet (1998), Pehnt (2006), Pacca et al. (2007), or Stoppato (2008) have tried to establish the environmental costs of the production process of photovoltaic technologies and materials, by applying LCA (life cycle assessment) methods. The environmental benefits of photovoltaic power have also been the subject of several studies, such as Scognamiglio and Rostvik (2012) – on sustainable buildings – or El Bassam and Maegaard (2004), on rural installations. On this question, Larcher et al. (2013) highlight the potential of photovoltaic power for rural development. Finally, other studies in the field of architecture such as those by Roberts and Guariento (2009), Martín and Fernández (2007), and Martín (2011) analysed the various means of integrating photovoltaic devices into the structure of buildings, and some of the solutions they propose (materials, shapes, colours) can also be applied to the components of photovoltaic plants.

Most research into renewable energies and landscape has centred on wind power (Nadaï and van der Horst 2010), and little research has yet been done on the landscape aspects of photovoltaic power, with some exceptions including Chiabrando et al. (2009) and Mérida et al. (2010), who researched the landscape impacts of photovoltaic plants, and Minichino (2013), who suggested that landscape design should become a criterion in photovoltaic energy policy. For its part, public perception of photovoltaic power has only been tackled in a few specific papers (Poize 2013; Mérida and Lobón 2012) and is hardly mentioned in studies of the general perception of renewable energies, above all wind power, such as those by West et al. (2010), Wüstenhagen et al. (2007) or Zoellner et al. (2008). Papers on social perception of renewables in Spain such as those by Frolova (2010), Frolova and Pérez (2011) and Frolova et al. (2013) have also focussed on wind energy. At a regional level, the expansion of photovoltaic power in Andalusia and its consequences have been researched by Prados (2010a) and by Mérida and Lobón (2012), whereas Prados (2010b) analysed the sectoral planning of this source of energy, within the framework of the various types of renewable energy. Initial research into the creation of new energy landscapes dominated by renewable energies in Spain has been done by Mérida et al. (2009), who focussed on the spatial combination of different energy installations, and by De Andrés and Iranzo (2011), who analysed their impact source by source, although the latter paper did not consider photovoltaic installations.

In addition authors studying landscape integration have traditionally focussed on installations on farm buildings located in rural areas (Ayuga 2001; Hernández et al. 2006; Rogge et al. 2008; Tassinari et al. 2007; Mérida and Lobón 2011; Riesco 2000; Sovinski 2009). However, many of their results can also be applied to photovoltaic plants.

As can be seen, the study of the relationship between photovoltaic energy and landscape is still at an early stage, and a lot of work remains to be done to improve our understanding, both in the analysis of the perceptive dimension of the installations and in their public perception and evaluation. We must also explore the landscape integration of photovoltaic installations and the new landscapes they are helping to form. This paper seeks to achieve these goals and to help us understand these relationships better.

14.3 Andalusia, Its Territory and Photovoltaic Energy Development

Andalusia is very well suited for the development of various renewable energies, and in particular the different forms of solar energy, such as photovoltaic power. As a result, renewable energy sources have been developed quickly and widely across the region and now account for 35.6 % of electricity generation (Agencia Andaluza de la Energía 2012).

Photovoltaic energy is ideally suited to the Andalusian climate. The region enjoys more sunshine than many other parts of Spain and indeed Europe. The sun shines for over 3,000 h a year in a large part of Andalusia, with the Mediterranean coast and the Guadalquivir valley receiving the greatest amounts. The intensity of solar radiation is also high – over 4 kWh/m^2 in the whole region (AEMET 2005).

In addition, a substantial part of the land is located on level or slightly undulating ground, especially in the Guadalquivir river valley. The region covers a large area, 84,000 km^2, with a population density that is average for Europe, but is concentrated in certain areas, such as the coast and the main metropolitan areas. There is therefore abundant available space in inland rural areas in the region, facilitating the setting up of this type of extensive installation due to the low price of the land and the higher returns offered by photovoltaic energy compared to traditional agricultural uses.

From a technological point of view, the region has a wide, high-voltage electricity distribution network that stretches over 9,000 km. Andalusia also has a significant industrial sector specialising in the field of renewable energies. Last but not least, in the first decade of this century, Andalusia, and Spain in general, made a commitment to encourage the development of renewable energies, introducing various laws and regulations offering substantial economic support to allow the sector to expand. However, with the onset of the economic crisis, in the last few years, this official support has been reduced drastically, slowing down the development of this energy sector. Despite the current circumstances, the official plans for the sector, namely, the Renewable Energies Plan 2011–2012 (Ministerio de Industria, Turismo y Comercio 2011) or the Andalusian Energy Sustainability Plan 2007–2013 (Agencia Andaluza de la Energía 2007), still somewhat paradoxically assert the enduring public commitment to the promotion of renewable energies.

Within this context, the production of photovoltaic power in Andalusia has undergone a rapid evolution. Whereas according to the Andalusian Energy Agency, the installed power in 2007 was 64.13 MW, by the end of 2012, it had reached 840.13 MW, a thirteenfold increase in only 6 years. Growth has not been constant over this period, with an initial period of spectacular increase to 663.28 MW in 2008. Since then, installed power has grown at a more moderate pace, with practically no growth at all in 2009 (665.91 MW) and slightly more sustained increases in 2010 (733.20 MW), 2011 (783.39 MW), 2012 (840.13 MW) and 2014 (883), in line with the changes in the regulations.

As a result of this whole process, photovoltaic power is now the second renewable energy source in Andalusia, after wind power. Of the total amount of electricity produced by renewable sources at the end Of the total amount of renewable installed power at the end of 2013 (6.016 MW), photovoltaic power accounted for 14.4 % and wind power 52.5 %.

In Spain as a whole, Andalusia is the second Autonomous Region in terms of installed photovoltaic power, after Castilla-La Mancha (ASIF 2011), and within Andalusia, most of the installed power is centred in the provinces of Seville and Cordoba, which together account for 46 % of the total (Table 14.1).

So far, photovoltaic power plants account for most of the installed power and the proportion of rooftop installations is noticeably lower, at 21.3 %, although this percentage has been gradually increasing in recent years and is expected to continue growing. There are significant variations from one province to the next, with the highest percentage of rooftop installations in Cadiz (34.8 %) and the lowest in Cordoba (12.4 %).

Table 14.1 Installed photovoltaic power (MW) in Andalusia by province (31/12/2014)

Province	MW	%
Almeria	84.67	9.58
Cadiz	73.54	8.32
Cordoba	195.06	22.08
Granada	96.47	10.92
Huelva	73.37	8.30
Jaen	91.83	10.39
Malaga	52.78	5.97
Seville	215.61	24.40
Total Andalusia	883.33	100.00

Source: Andalusian Energy Agency

The photovoltaic plants we have analysed (virtually all those currently existing) are mostly situated in the provinces of Seville (27.2 %) and Granada (19.3 %), while most of the land occupied by these installations (64.5 %) is concentrated in the provinces of Seville, Granada and Cordoba.

14.4 Landscape Features of Photovoltaic Plants

The photovoltaic plants so far installed in Andalusia are scattered across the territory and occupy a relatively small area. For these reasons, more than new types of landscape, in those places where they are relatively frequent, they should be considered as components of the landscape and in those where there are relatively few, as special landscape features. Only in those situations in which the plants are installed in association with other renewable energy facilities, such as thermo-solar or wind energy, occupying a significant area (several km^2) and laid out practically adjacently with only small spaces in between can we talk about a specific type of landscape, a renewables landscape (Mérida et al. 2009).

The perceptive dimension of a photovoltaic plant depends primarily on its typological characteristics and the visual relationships it establishes with its environment. A landscape analysis of photovoltaic plants must therefore take several variables into account: their location and site, their density, the design of the installation as a whole, the specific design of the various devices and components, and the internal layout of these components. We will now analyse these factors for the case of photovoltaic installations in Andalusia (Fig. 14.1).

Fig. 14.1 Photovoltaic power plants in Andalusia (2009) (Source: Mérida and Lobón 2012)

14.4.1 Location and Site

The photovoltaic power plants in Andalusia are spatially centred around the Guadalquivir valley and in the fertile plains and the plateaus between the mountains of the Betic mountain ranges. In general, there are very few plants in mountain terrains, due to both topographic reasons and to the lack of infrastructure (electrical and other types) in these areas. They are also relatively scarce in coastal areas, although in this case, this is due to competition from other productive activities such as tourism and intensive agriculture. In the same way, they are practically non-existent in peri-urban and metropolitan areas. In any case, there is one essential location criterion: proximity to the main electricity distribution networks.

On a more detailed scale, the installations we analysed were most frequently located on two types of physiographic unit: hillocks and hills, in 42 % of the cases, and plains (fluvial, plateaus, intra-mountain basins, etc.) in 41 %. There are relatively few sites on very sloping hillsides (4.5 %), peaks (2.3 %), foothills (6.8 %) and valley floors (3.4 %). Normally, the land on which they were installed had previously been used in agriculture (70 % of the cases), mainly tree plantations and olive groves, which provided lower returns than photovoltaic energy. It is precisely because of their frequent location on agricultural land and their original modest dimensions that photovoltaic power plants are often referred to as 'solar farms'.

The rapid proliferation of photovoltaic plants has made their effective control in territorial planning difficult, and they now appear in practically any type of landscape. Only protected areas have remained unaffected by this phenomenon, while the expansion in ordinary landscapes, by contrast, has occurred in a disorganised, uncontrolled way with no landscape management.

14.4.2 Density

In general terms, the density of photovoltaic power plants in terms of the area they occupy as a proportion of the whole territory of Andalusia is not very high (they cover a total area of 1,000 ha in a territory measuring 87,500 km^2), even in their preferred locations. They can occasionally reach higher densities in specific areas and municipalities, where various photovoltaic power plants are grouped together within one single panoramic view. In any case, the visual prominence of these installations, often in stark contrast with traditional land uses in the rural areas where they are located, makes them seem more densely deployed than they actually are.

14.4.3 Overall Design of Photovoltaic Power Plants

The overall design of photovoltaic power plants encompasses various different factors, such as the occupied space, their exterior morphology, their internal composition, the changes made to the terrain, the conservation of pre-existing features or the characteristics of perimeter fencing. As regards occupied space, if they are compared to the other energy installations, especially conventional energy plants, photovoltaic power plants are relatively large installations, each occupying an average of 13.81 ha in Andalusia. However, this average value is not considered to be significant, due to the fact that large installations, 7 % of those analysed, account for almost 35 % of the occupied space, a reflection of the current tendency towards large-scale plants, in which plants of tens and even hundreds of hectares are increasingly frequent, whereas the first solar farms normally only covered 1 or 2 ha. This trend is closely linked with the gradual reduction of public subsidies and with big companies entering the sector.

As regards the exterior morphology, most plants have a rectangular floor plan for both technological and operational reasons. The fact that they are often sited on previously farmed fields also explains the predominance of regular shapes. Internally the photovoltaic power plants tend to be fragmented into sectors, both for technical reasons (access for maintenance purposes) and due to regulatory factors because, for a time, the legal fragmentation of a single complex into smaller independent installations enabled developers easier access to subsidies.

In general, these installations do not entail significant modifications of the terrain because they are not required and would increase the cost of the investment, although, in some cases, an unsuitable site selection means that earth has to be moved and terraces, slopes and retaining walls have to be built. This happens above all on hillsides or on the top of hills.

In general terms, the overall design of the plants does not usually take into account the conservation, exploitation or reuse of pre-existing features (both natural and artificial), although, in some cases, some of the original most distinctive trees are preserved. Some old agricultural buildings occasionally remain within photovoltaic plants, although they normally have no specific use and lie abandoned in ruins.

Most photovoltaic power plants use perimeter fencing to protect the installation. Some use transparent fencing, generally made of metal mesh, while others have solid walls made of concrete and, occasionally, of masonry.

14.4.4 Design of the Components

The main components of photovoltaic installations are photovoltaic panels, which consist of modules which in turn are made up of cells. These photovoltaic panels are installed on top of support structures, which can be stationary or mobile, and follow the course of the sun, on one or two axes. These support structures can be laid out in rows or independently of each other. Normally, these independent structures have a tracking mechanism and are known as trackers. In Andalusian photovoltaic power plants, fixed row structures are more common, featuring in 58 % of the installations.

The modules on photovoltaic panels are made of different materials, of which monocrystalline, multicrystalline and amorphous silicon, in this order, are most commonly used. Apart from these solar sensors, photovoltaic plants also have other components of great importance for the landscape, such as transformers, electricity transmission towers and cables, road networks (both the network providing access to the installation and the internal network) and large information or advertising panels.

14.4.5 Internal Layout of the Components

The distribution of the structures depends on the typology used. The installation of continuous rows is laid out symmetrically in alternate regular strips. In the installation of free-standing solar trackers, the only common theme is the geometrical layout, within a regular frame, similar to that used in fruit farms. Auxiliary technical installations also have internal organisation standards. In general, regular layouts are usual, although in some cases these installations are laid out irregularly in groups (Fig. 14.2).

Fig. 14.2 Trackers in photovoltaic power plant (Fuensanta, Granada province)

14.5 Effects of Photovoltaic Plants on Landscapes

14.5.1 General Principles

The effects of photovoltaic plants on landscapes are the result of two characteristics of these installations: their outward appearance and the meanings they incorporate into the landscape. These characteristics correspond to the different stages of the perception process: sensation and perception (Matlin and Foley 1996). The *physiognomy* of photovoltaic plants is manifested in the presence of specific geometries, compositions, textures and colours and, especially, in the reflection or brightness of their most characteristic components.

These installations also have specific associated *meanings*: first of all, and as with other renewable energy plants, that relating to the clean, renewable and natural energy they produce. They also transmit messages relating to their productive nature (industrial activity, as a sign of progress and prosperity or as a sign of the denaturalisation of rural spaces) and their innovative nature, resulting from their recent origin and expansion, which links them (positively or negatively) with the idea of modernity.

The impacts on the landscape are produced in two ways (Gómez Orea 1999): the influence on the spaces occupied by these installations (intrinsic landscape) and the alteration of the visual conditions of the territory (extrinsic landscape). This impact on the landscape is normally regarded as negative in environmental impact reports, even though these installations, like other energy or transport infrastructures, have certain aspects which, if valued, could help to enhance landscapes and bring about a positive impact. In any case their effects on the landscape are synergistic, cumulative and reversible, an especially important feature.

The effects of photovoltaic plants on landscapes result from the factors which affect their landscape characterisation, as explained in the following sections.

14.5.2 Location and Site as Impact Factors

Depending on their productive nature, the typological singularity of their components and their density, photovoltaic power plants produce more landscape impacts on rural areas than on others more subject to human action, altering the identity and the landscape meaning of these areas. The rural space in Andalusia has valuable natural and agricultural landscapes, and even though many of them are inherently dynamic, in general, they have only undergone minimum transformation and they have no large industrial areas and have not experienced intensive urban development processes. Some of these landscapes are considered as part of local or regional identity, as is the case of olive groves, fluvial landscapes, traditional irrigated land, extensive cultivated areas and mountain landscapes. However, it is in these rural areas rather than in more economically dynamic spaces that most photovoltaic plants are normally installed.

Within rural areas, in principle, the impact is perceived as being less significant on agricultural terrains, where human presence has already modified the land surface, introducing regular shapes, human constructions and other more recent installations, such as greenhouses. In natural spaces, however, the contrast is usually much greater, leading to clear conflicts with the existing landscape character. In these areas, the impact on the landscape may also come in the form of significant topographic alterations.

The location of photovoltaic plants in open areas, their often large dimensions and the reflection from their panels make them visible from many places. The viewsheds they create are generally very large, over 10,000 ha in practically half of the cases we analysed. In addition, their position next to transport networks (almost two third are situated in the vicinity of highways and major roads) increases the number of potential observers, in other words, their visual effect. On other occasions, the impact is produced because of the intrusion of photovoltaic plants on views with a high scenic value (Fig. 14.3).

Fig. 14.3 Landscape impact of photovoltaic power plant in mountain area (Moclinejo, Málaga province)

14.5.3 Density and Landscape Impact

The landscape impact of a high density of installations lies in their synergistic character: the overall effect is higher than the sum of the individual impacts. The impacts on the landscape are higher when photovoltaic power plants are arranged in a scattered way on the land, generating discontinuity and areas with gaps which are rendered useless. Nevertheless, the concentration of photovoltaic power plants in specific areas, apart from grouping impacts together, can also lead to the creation of a new specialised landscape, particularly if they coincide spatially with other renewable energy sources (Mérida et al. 2009) and, above all, if quality is central to their designs. A process of this nature is taking place in the El Marquesado area in the province of Granada, where the density of photovoltaic and other renewable energy sources is relatively high, although they have yet to be treated together as part of a territorial whole.

14.5.4 Impact of the Overall Design of Photovoltaic Power Plants

Photovoltaic plants cover a large area compared to other sources of energy, especially conventional ones. In addition to the total dimensions, the impact on the landscape can also result from the contrast between the size and external morphology of the photovoltaic installation and the size and external morphology of the pre-existing plots of land. If the plots are of varying sizes and shapes, the impact of a photovoltaic installation could be reduced by adapting the shape and size of the plant to those of the plots of land (Fig. 14.4).

In terms of composition, the fragmentation of the installation or its division into sectors produces a significant impact on the landscape, due to the introduction of orthogonal axes or strips corresponding to the gaps, unusual geometries in rural areas, and to the colour contrast between these discontinuities and the areas occupied by photovoltaic panels.

Topographic alterations also have a very important impact on the landscape as a result of the introduction of geometrical shapes and lines, the use of nontraditional materials in retaining walls or the higher reflectivity of bare rocks. The positioning of the structures can cause important effects on the landscape, particularly if the rows of panels are installed perpendicular to the contour lines. Semantically, the alteration of the relief causes serious impacts due to the lack of landscape coherence and legibility (Kaplan and Kaplan 1989). This same effect on the nature of landscapes occurs with the abandonment of old traditional buildings that are enclosed within photovoltaic plants, which in functional terms also represent a waste of resources that could have been given a new use in designs of a higher quality.

Fig. 14.4 Photovoltaic power plant adapted to plots of land (Ardales, Málaga province)

Finally, on some occasions, the fencing around the plants can also produce impacts on the landscape, sometimes to a greater extent than the installation itself, particularly if hard morphologies and opaque materials with high albedo, such as concrete, are used.

14.5.5 Design of the Components and Their Impact

To a large extent, the landscape impacts of photovoltaic power plants are due to the visual importance and the semantic singularity of their components, industrial and futuristic-looking devices that contrast sharply with neighbouring traditional rural uses of land, affecting the character of landscapes and making their perception difficult, even more so if they are deployed intensively over a short period of time.

The landscape impact of the components starts with the photovoltaic structures themselves. Photovoltaic panels have an intense brightness due to the fact that a great part of the solar energy they receive is reflected (around 80 %), making them visible from a great distance. The materials used react differently in chromatic terms. In general, monocrystalline silicon modules show a homogeneous colour somewhere between blue and grey, multicrystalline silicon modules produce an intense bluish colour and a heterogeneous texture and amorphous silicon modules have a homogeneous appearance and a dark colour. The dividing lines between the modules also influence the image of the panels as do the frames. The structures supporting the panels are also of great visual importance, especially in free-standing structures, which create a vertical axis, raising the panels off the ground and making the supporting mast visible, as well as interrupting the sheetlike continuity of the panels. The negative impact is greater in treeless, essentially horizontal landscapes, such as cereal-growing areas. In the case of panels aligned in rows, this interruption of continuity is less noticeable, although the alternate strips between the rows are visible, especially from the sides of the plants. If structures have a tracking system, the impact is higher because the position and orientation of the panels are constantly changing throughout the day, a movement which, although slow, undoubtedly has an impact on the landscape.

The rest of the components of photovoltaic power plants stand out less than the module structures although, in some cases, they are also clearly noticeable. The transformers, for instance, are visible because of their size and colour and also because they reinforce the industrial, urbanised perception of the landscape. Paths and access roads can cause some impact depending on their design, the modifications to the land they entail or the particular road surface used, while both transmission towers and information and advertising panels stand out in the landscape, above all, because of their vertical typology and their location in a prominent position.

14.5.6 Internal Organisation of Components and Their Impact

The way the components of a photovoltaic installation are grouped together is of outstanding visual importance, especially from the middle and long distance, from which the design of the components is less noticeable. In plants with continuous rows of modules, this impact occurs when the alternating strips of structures and unoccupied land are visible, and is greater when the rows are positioned perpendicular to the natural contour lines, if different orientations are mixed within the same installation or if similar alignments do not exist in the surrounding landscape as a form of reference. This impact is very significant in natural areas where concepts of order and symmetry do not apply.

In the installations with free-standing solar trackers, the landscape impact of the layout pattern depends on the contrast it produces with the existing pattern in the landscape. This means that the use of geometrical patterns is unsuitable in areas with an irregular layout pattern, such as pasture land, whose character and coherence would be affected. On the contrary, the impact is noticeably reduced if there are regular layouts in the surrounding area and if the alignments follow those in the vicinity.

The internal organisation of auxiliary technical installations can also produce important landscape effects, especially in installations with fixed row structures in which the support structures are lower. In principle, the impact of regular layouts is higher, as in the case of row structures, they can interrupt the sheetlike continuity of the panels. Nevertheless, if distribution patterns coincide with those of existing isolated buildings, impacts would be reduced.

The research team has systematised the factors and components involved in the perception of photovoltaic plants, and this needs to be complemented with an analysis of the social valuation of these installations, in line with the premises set out in the European Landscape Convention, as a means of moving on from the potential impact to the real impact as perceived by local people. We have therefore made a survey of public opinion, which we will now go on to describe.

14.5.7 Impact of Photovoltaic Plants and Their Public Perception

We complemented our assessment of the impacts of photovoltaic plants on the landscape with an analysis of public perception of these impacts. In order to gauge the level of public concern in Andalusia, a survey of inhabitants of areas near photovoltaic plants was carried out during 2009, involving a total of 82 personal interviews distributed in 4 populated areas of different provinces. Our target group was also divided by age group and sex from the population of over 16 years of age from each town or village, according to the quota sampling technique. From the analysis of the results, we deduced that photovoltaic installations are viewed positively (63.4 %), and that 58.5 % of those interviewed consider them to be beneficial for their area, because of the economic, employment and environmental benefits they bring, although they also put forward mistaken arguments in favour, such as better electricity supply and cheaper electricity for local residents. This acceptance of photovoltaic plants confirms the findings of Europe-wide reports on solar energy in general (European Union 2007). Likewise, most of the interviewees considered that solar energy in all its various forms has a great future. Nonetheless, this support fell to 35 % and opposition rose to 45.1 %, when they were asked about possible proliferation of photovoltaic plants or an increase in their size. Those opposing such changes cited landscape protection as the main reason for their opposition. These results imply that people prefer photovoltaic plants as special features in the landscape rather than as components of the landscape or as a type of landscape.

Aesthetically speaking, however, a large majority of those interviewed (56 %) found the plants unattractive, although a significant minority (29 %) considered them aesthetically appealing. They associated their image with that of other landscape components such as water, greenhouses, warehouse roofs or industrial units. The impact is perceived both on the views and on the contents of the landscape.

The weighted evaluation of the landscape in the area where the interviewees live offers a high average score (7.62 points out of 10), but this drops to 5.46 if photovoltaic plants are included. This initial approximation would suggest therefore that according to the people interviewed, the loss of landscape quality produced by photovoltaic plants could be estimated at around 20 %. This negative opinion of the impact of these plants on the landscape is reinforced by the fact that the survey respondents stated that they would prefer them to be installed in poorly visible sites (65.6 %) and that given the choice they prefer (48.7 %) the installations on the roofs of buildings, although in one of the villages, those interviewed also opposed roof installations due to their possible impact on their urban landscape.

There is, therefore, an important imbalance between the positive public perception of the economic and productive benefits of photovoltaic plants and the negative perception of their effects on the landscape. The perceived negative consequences on the landscape do not however prevent an overall positive rating. To some extent these negative consequences are considered an inherent part of energy development, and some interviewees even cited a widely held principle in rural communities, namely, the freedom of the owner to use the land for whatever purpose he/she deems fit.

The fact that there are seemingly contradictory opinions must be seen as an opportunity rather than as a problem: there is a positive opinion about the general nature of the installations that can be extended to their location and their outward appearance. The introduction of quality designs would make it possible to compensate for this imbalance, which means that landscape integration measures are of great importance.

14.6 Planning Tools: Landscape Integration Proposals

The landscape integration of photovoltaic power plants is a very useful tool for the territorial planning of this productive sector. On the one hand, it reduces the possible landscape repercussions of these installations, and on the other, it can give the photovoltaic power plant an added value – landscape quality – as a result of design quality and careful selection of the best site. Landscape integration can be defined as a territorial intervention procedure that aims to guide and shape landscape transformations in order to adapt them to the type of landscape taken as a reference (Mérida and Lobón 2011). Depending on its quality, the reference landscape can be both the present and the pre-existing one or any other proposed in the landscape quality objectives. In this section, on the basis of our analysis of the situation in Andalusia, we provide some possible guidelines about landscape integration that could be applied in the case of these installations. These are based on the landscape integration strategies and techniques (Ayuga 2001; Busquets and Cortina 2009; Mérida and Lobón 2011), the landscape impact principles and the results of the interviews we carried out.

14.6.1 Proposals for Location and Site

The landscape integration criteria relating to location depend on the scale being used. At a subregional level, different types of landscape and landscape components can be proposed in which or around which the installation of photovoltaic power plants does not alter the essence of the landscape. Many of them can even be used to increase the value of their landscape, contributing, in some cases, to the reuse of impoverished spaces and, in others, to the improvement of landscapes of a higher quality. For this reason the landscapes listed below could be highly suitable locations for these installations, because of both their common features (colour, morphology, size, type) and their shared or close meaning to that of photovoltaic power plants: transformation, infrastructure, innovation or singularity. In Andalusia there are many such landscapes and landscape components, including: areas with large numbers of greenhouses, industrial landscapes, mining spaces, peri-urban areas, water landscapes (even on floating structures), energy landscapes (both conventional and renewable) and transport infrastructures, such as roads, railways, airports and ports. In these cases, the photovoltaic installations could be placed on top of these infrastructures (e.g. acoustic screens, top of fake tunnels, dykes in ports, etc.), near transport and other networks or in the large empty spaces confined within transport infrastructures.

As regards the site, a suitable site for photovoltaic installations must take into account different criteria, such as the selection of flat or plateau terrains, with reduced viewsheds, low visual impact on populated or busy areas and far away from high-quality views and from exceptional elements in the landscape, especially those of a cultural nature. We also recommend that plants be sited on unproductive land as this new function would give the landscape more coherence or purpose. It is also necessary to take into account the relationship between local people and their landscape, ruling out as possible sites the most highly valued spaces or those in greatest demand for other social and economic functions.

14.6.2 Proposals for the Overall Design of Installations

The size of photovoltaic power plants must be regarded both in general terms, preferring small and middle-sized plants to large ones and, in relative proportions, adapting their size to the dimensions of nearby farms. Likewise, their external morphology must fit in with the characteristic shapes of the farms around them, be they linear or en masse, geometrical or irregular. The internal composition must seek homogeneity, reducing the gap strips to a minimum and avoiding the combination of different types of solar sensors.

In order to attain an acceptable level of landscape integration, another crucial criterion is adaptation to the relief. On sloping terrain the structures must be positioned parallel to the contour lines, ensuring integration on the horizontal plane, the plane of human sight. Changes to the ground surface (artificial slopes, embankments, etc.) should be avoided and, if this is not possible, specific corrective measures must be applied. In addition, the general design must try to preserve pre-existing elements – both natural and artificial and especially traditional constructions – giving them a new function. Finally, the type of perimeter fencing should be chosen carefully, preferably opting for transparent fencing materials with low visual impact and preserving the existing lines of traditional boundaries in their design.

14.6.3 Proposals for the Design of Components

An essential aim of landscape integration of photovoltaic power plants must be to insert the modules and panels, their main components, into the landscape more effectively. This does not necessarily mean hiding them; indeed their prominent position in the landscape can be maintained if the right measures are taken. In the case of photovoltaic modules, it is important to disguise the dividing lines between the cells by adapting their colour to match that of the cells. The shape of the modules can also be improved by exploring new possibilities which go beyond the omnipresent four-sided figures, as has happened, for example, in urban design with 'photovoltaic trees'. It would also be advisable to use larger modules (if the size of panels does not increase), as they would create a continuous surface on the panel similar to other landscape components (water sheets, greenhouses, industrial roofs), thereby integrating the modules more easily. The visual impact of module profiles must also be reduced by colour treatments or by using other materials.

In order to improve the landscape integration of modules, more suitable colours must be found. Amongst the most commonly used materials, monocrystalline silicon gives the best results for the landscape, due to its greyish tones, similar to those of other landscape components. Photovoltaic modules could also use other colours that are not currently used in photovoltaic power plants but are appearing, little by little, in architectural integration of this energy source. For this reason extending their use to photovoltaic power plants could be an important future challenge; the problem is that they are more expensive and less efficient. In any case, their obvious benefits for the landscape (and therefore for society) could bring added value to the installation, in terms of increased quality and prestige.

As regards the support structures, these are generally better integrated into the landscape when installed in rows rather than in groups of free-standing trackers, due to the fact that they more easily resemble other landscape features, such as water, industrial warehouses or greenhouses. By contrast, the landscape integration of free-standing solar trackers is more complicated because of their vertical structure and their scattered nature, although they can integrate better into industrial and similar areas and into rural areas that have isolated landscape components that are similar in shape (tree crops) or meaning (wind turbines).

Morphologically, it is important to design support structures that are innovative and have a design quality that goes beyond mere functionality. The incorporation of new landscape-friendly shapes would give the installation an image of quality, and of concern about design and about the environment, and this would benefit the company. Nevertheless, up until now, aesthetic criteria have not been taken into consideration in their design, and four-sided shapes predominate.

Both support structures and panels are more easily integrated the smaller they are. It would be advisable to establish size limits, even if this meant that more structures had to be installed: horizontal developments are preferable to vertical ones, in that they are parallel to the human plane of vision. Changing their colour to fit in with the existing tones in the environment would also be a good integration strategy.

In the case of auxiliary constructions, the best designs would be primarily horizontal with appropriate colour and texture, in order to assimilate them into the surrounding environment or nearby landscape references. Electricity transmission towers are difficult to integrate and therefore must be placed in areas of little visual importance. Information panels are equally difficult to integrate: their size and number must therefore be regulated and they must not be sited in sensitive landscape areas. The background colour of the panels should blend in with the colours in the surrounding environment.

In order to improve the landscape integration of access and internal road networks, particular attention must be paid to their design, especially in mountain areas, reducing steep profiles and topographic alterations. The surface of these roads must blend in with the area in terms of colour and texture.

14.6.4 Proposals for the Internal Organisation of Components

Successful landscape integration of photovoltaic power plants also depends on the correct internal distribution of their component parts. If panels are arranged in continuous rows, these must be organised in a rectangular way, with the minimum possible gap between them. They should also be aligned with any other pre-existing lines in the landscape, parallel to the contour lines on sloping land, and with the minimum gap required for technical reasons. As far as is possible, the gap strips should only be visible from places with few potential observers. Free-standing solar trackers, for their part, must be grouped together to form a homogeneous mass of panels. They must be laid out in a similar way to existing landscape features such as olive groves, fruit orchards or *dehesa* grazing land. Any auxiliary technical installations should where possible be grouped together in less visible places. In any case these elements must be laid out in such a way as to reproduce the distribution pattern in the surrounding landscape.

14.6.5 Implementation of Measures to Correct Landscape Impact

Corrective measures are specific actions in the landscape that seek to mitigate impacts that have already been caused by the unsuccessful integration of the plant into the landscape, due either to its location or its design. These measures are usually of limited effectiveness, due to the dimensions of the photovoltaic power plant and to their very nature, in that they must be exposed to the sun and cannot therefore be hidden from view. Corrective measures can however be very useful for adapting certain parts of the photovoltaic power plant into the landscape, for example, the artificial slopes and embankments sometimes created during installation. They can also be used to improve the landscape integration of perimeter fencing, internal roads and the free spaces between them. Their effectiveness on support structures is more limited, as less can be done for technical reasons. On the other hand, corrective measures in the landscape can be useful if they are also applied in the surrounding areas, such as in the spaces between the viewpoints and the installation (e.g. by maintaining pre-existing tree alignments).

Of the various corrective measures, visual screens made of trees are probably the most suitable for installations with free-standing solar trackers and for those situated at a higher level than the viewpoints. They can also help mask perimeter fencings. In treeless areas, by contrast, planting trees can intensify the presence of these installations on the landscape.

Visual screens can also be of a topographical nature, involving some earthmoving, or be constructed. In this sense, the use of walls can be appropriate in areas in which walls are a feature of the landscape, in which case similar materials and designs must be used. Platforms built for other infrastructures nearby, such as roads, canals, etc., can also be used.

Other corrective measures apart from visual screens can also be introduced. These include the placing of transition features (visual or semantic) in the spaces between the viewpoint and the plant or between components of the plant of different kinds. Finally, other possible corrective measures include modifying the textures and colour of specific components of the installation using plant textures for bare lands, stone and ceramic coverings or colour treatment.

Corrective measures may be applied to the plant as a whole or to its perimeter, although they are more effective if they focus on certain specific components or on one or more of its sides. Given that the landscape identity of these installations is provided by photovoltaic modules and panels, components that are more easily adaptable to the landscape but at the same time more difficult to hide, it makes more sense to apply these corrective measures to the sides and back of the installation, where most of the problems arise.

14.7 Conclusions

In the recent development of photovoltaic plants in Andalusia, landscape criteria have played no part in their territorial implementation and design, so that in most cases these plants are perceived as impacts on the landscape. The landscape treatment of these installations would not only reduce their possible impact but would also help improve and enrich the quality of landscapes. Our analysis of the experience of Andalusia has enabled us to reflect on the causes and intensity of this effect on landscapes and on how impacts may be mitigated and indeed reversed by drawing up landscape integration proposals applicable to both current and future installations in Andalusia and elsewhere.

The social benefits arising from the adoption of this good landscape practice can lead to other kinds of benefits, such as the political rewards earned from the positive image of photovoltaic power amongst the general public. Investors can also benefit from the incorporation of certain landscape integration measures which increase the added value of the installations: promoting the image and reputation of the companies, attracting the attention of visitors or developing patents and technologies relating specifically to landscape. This also shows the increasing importance of making landscapes and landscape integration a part of the Corporate Social Responsibility (CSR) of large companies.

In any case, the development of photovoltaic plants is still at an early stage, in which productive efficiency seems to be more important for investors than other considerations (such as landscape criteria). However, as has happened with other infrastructures such as transport, photovoltaic energy development is expected to lead to increased demands for improving the quality of the installations and an ordered, sustainable process of territorial deployment. In this sense, landscape integration may help bring about a more positive reappraisal of photovoltaic plants in which they can be viewed as potential landscape resources.

Acknowledgements This chapter includes and enhances the results of the research project 'Estimation of impacts and landscape integration proposals of the installations which generate solar photovoltaic power in Andalusia', financed by the Regional Ministry of Public Works and Transport of Andalusia.

References

AEMET (2005) Atlas de radiación solar de España. AEMET, Madrid
Agencia Andaluza de la Energía (2007) Plan Andaluz de Sostenibilidad Energética 2007-2013
Agencia Andaluza de la Energía (2012) Informe de Infraestructuras Energéticas en Andalucía
Aguado-Monsonet MA (1998) The environmental impact of photovoltaic technology. INTERSUDMED project. Institute for Perspective Technological Studies, Sevilla

Ardillier-Carras F, Balabanian O, de Andres C (2011) Les noveaux paysages energetiques en Espagne. In: Humbert A, Molinero F, Valenzuela M (eds) España en la Unión europea. Un cuarto de siglo de mutaciones territoriales, Colecction de la Casa de Velazquez, 121. Madrid, pp 41–58
ASIF – Asociación de la Industria Fotovoltaica (2011) Hacia el crecimiento sostenido de la fotovoltaica en España. Madrid
Ayuga Téllez F (2001) Gestión sostenible de paisajes rurales. Técnicas e ingeniería. Fundación Alfonso Martín Escudero, Madrid
Busquets J, Cortina A (2009) Gestión del Paisaje. Ariel, Barcelona
Chiabrando R, Fabrizio E, Garnero G (2009) The territorial and landscape impacts of photovoltaics systems: definition of impacts and assessment of the glare risk. Renew Sust Energ Rev 13:2441–2451
Council of Europe (2000) European Landscape Convention. European Treaty Series 176
de Andrés Ruiz C, Iranzo García E (2011) Desarrollo de las energías renovables y cambios paisajísticos: propuesta de tipología y localización geográfica de los paisajes energéticos en España. In: Gozálvez V, Marco JA (eds) (2011) Energía y territorio. Dinámicas y procesos. AGE-Colegio de Geógrafos de España-Universidad de Alicante, Murcia, pp 97–107
de la Hoz J, Martín H, Martins B, Mata J, Miret J (2013) Evaluating the impact of the administrative procedure and the landscape policy on grid connected PV systems (GCPVS) on-floor in Spain in the period 2004-2008: to which extend a limiting factor? Energy Policy 63:147–167
El Bassam N, Maegaard P (2004) Integrated renewable energies for rural communities. Elsevier, Amsterdam
European Union (2007) Eurobarometer 2007. Energy technologies: knowledge, perception, measures, Luxembourg
Frolova M (2010) Los paisajes de la energía eólica: su percepción social y gestión en España. Nimbus 25–26:93–110
Frolova M, Pérez Pérez B (2011) New landscape concerns in development or renewable energy projects in South-West Spain. In: Roca Z, Claval P, Agnew J (eds) Landscapes, identities and development. Ashgate Publishing, Farnham, pp 389–401
Frolova M, Bejarano JF, Torres A, Lucena M (2013) Valoración social. In: Ghislanzoni M (ed) Guía de integración paisajística de parques eólicos en Andalucía. Consejería de Medio Ambiente y Ordenación del Territorio, Sevilla, pp 65–78
Gómez Orea D (1999) Evaluación del Impacto Ambiental. Mundi-prensa, Madrid
Hernández J, García L, Ayuga F (2006) Assessment of the visual impact made on the landscape by new buildings: a methodology for site selection. Landsc Urban Plan 68:15–28
Kaplan R, Kaplan S (1989) The experience of Nature. A psychological perspective. Cambridge University Press, New York
Larcher F, Novelli S, Gullino P, Devechi M (2013) Planning rural landscapes: a participatory approach to analyse future scenarios in Monferrato Astigiano, Piedmont, Italy. Landsc Res. doi :10.1080/01426397.2012.746652
Martín N (2011) Integración de la Energía Fotovoltaica en los edificios. Progensa, Sevilla
Martín N, Fernández I (2007) La envolvente fotovoltaica en la arquitectura: criterios de diseño y aplicaciones. Reverté, Barcelona
Matlin M, Foley H (1996) Sensación y percepción. Prentice Hall, Mexico
Mérida M, Lobón R (2011) La integración paisajística y sus fundamentos. Metodología de aplicación para construcciones dispersas en el medio rural. Boletín Asociación Geógrafos Españoles 56:263–294
Mérida M, Lobón R (2012) Paisajes solares. Integración paisajística de plantas fotovoltaicas en Andalucía. CEPT Consejería Obras Públicas y Transportes, Sevilla
Mérida M, Pérez B, Lobón R, Frolova M (2009) Hacia la caracterización del paisaje de energías renovables. In: Pillet F, Cañizares MC, Ruiz A (eds) Geografía. Territorio y Paisaje. El estado de la cuestión. AGE, Madrid, pp 1193–1210
Mérida M, Lobón R, Perles MJ (2010) Las plantas fotovoltaicas en el paisaje. Tipificación de impactos y directrices de integración paisajística. Nimbus 25–26:129–154

Minichino S (2013) What does landscape have to do with renewable energy policies? Quaderni di Careggi 4:57–59
Ministerio de Industria, Turismo y Comercio (2011). Plan de Energías Renovables 2011-2020
Nadaï A, van der Horst D (2010) Introduction: landscapes of energy. Landsc Res 35(2):143–155
Pacca S, Sivaraman D, Keoleian G (2007) Parameters affecting the life cycle performance of PV technologies and systems. Energy Policy 35:3316–3326
Pehnt M (2006) Dynamic life cycle assessment (LCA) of renewable energy technologies. Renew Energy 31:55–71
Poize N (2013) Landscape, photovoltaic plants and participatory process in natural regional parks of Rhône-Alps. Quaderni di Carregi 4:60–62
Prados MJ (2010a) Renewable energy policy and landscape management in Andalusia, Spain: the facts. Energy Policy 38:6900–6909
Prados MJ (2010b) ¿Energías renovables o agricultura? Un análisis de la percepción ciudadana sobre los huertos y latifundios solares en Andalucía. Nimbus 25–26:205–229
Riesco P (2000) La interpretación de perturbaciones en el paisaje rural. Propuestas de atenuación. Andalucía Geográfica 7:27–33
Roberts S, Guariento N (2009) Building integrated photovoltaics: a handbook. Birkhäuser, Basel
Rogge E, Nevens F, Gulinck H (2008) Reducing the visual impact of greenhouse parks in rural landscapes. Landsc Urban Plan 87:76–83
Scognamiglio A, Rostvik H (2012) Photovoltaics and zero energy buildings: a new opportunity and challenge for design. Prog Photovolt. doi:10.1002/pip 2286
Sovinski R (2009) Materials and their application in landscape design. Wiley, London
Stoppato A (2008) Life cycle assessment of photovoltaic electricity generation. Energy 33:224–232
Tassinari P, Torreggiani D, Paolinelli G, Benni S (2007) Rural buildings and their integration in landscape management. Agric Eng Int: CIGR EJ. Manuscript LW07020-IX
Tsousos T, Frantzeskaki N, Gekas V (2005) Environmental impacts from the solar energy technologies. Energy Policy 33:289–296
West J, Bailey I, Winter M (2010) Renewable energy policy and public perceptions of renewable energy: a cultural theory approach. Energy Policy 38:5739–5748
Wüstenhagen R, Schweizer-Ries P, Wemheuer C (2007) Social acceptance of renewable energy innovation: an introduction to the concept. Energy Policy 35:2683–2691
Zoellner J, Schweizer-Ries P, Wemheuer C (2008) Public acceptance of renewable energies: results from case studies in Germany. Energy Policy 36:4136–4141

Chapter 15
GIS, Territory, and Landscape in Renewable Energy Management in Spain

Pilar Díaz-Cuevas and Javier Domínguez-Bravo

Abstract Geographical information systems (GIS) must play an important role in the development of a new model for the rational and integrated planning of renewable energies. They can also facilitate the decision-making process from a territorial and landscape perspective. The importance of GIS has increased in recent years with the development and implementation of the INSPIRE Directive in Europe, which has led to substantial improvements regarding access to and dissemination of geographical information, and has permitted the creation of new indicators and methodologies for the management of this type of energy. Despite GIS being one of the most powerful tools in any planning process, its successful use requires the prior definition of a referential conceptual framework for each territory and of the scale at which the analysis will be performed. The purpose of this work is to perform a comparative analysis of various different experiences of wind power planning at different scales using GIS in Spain, a country in which this type of energy has been widely deployed, focusing particularly on the methodologies applied and on the main problems preventing effective use of this tool. We also describe two experiences of planning using GIS in Andalusia (Southern Spain), in which access to and dissemination of geographical information was improved, enhancing public participation in the planning process and optimizing its management.

Keywords Geographical information systems • Wind power • Planning • Landscape • Spain

P. Díaz-Cuevas (✉)
Dpto. de Geografía Física y Análisis Geográfico regional, Universidad de Sevilla, C/Doña María de Padilla s/n, 41004 Seville, Spain
e-mail: pilard@us.es

J. Domínguez-Bravo
Departamento de Energía, División de Energías Renovables, Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT), Av. Complutense, 40, 28040 Madrid, Spain
e-mail: javier.dominguez@ciemat.es

M. Frolova et al. (eds.), *Renewable Energies and European Landscapes*,
DOI 10.1007/978-94-017-9843-3_15

15.1 Introduction

Renewable energies are in most cases positively regarded by politicians, trade unions and society at large, because, amongst other reasons, they offer real opportunities to promote better balanced, endogenous territorial development (Díaz et al. 2010; Espejo and García 2012). However, the speed of their deployment, their excessive concentration and their competition with other land uses have given rise to numerous conflicts in relation to plant location, sometimes resulting in strong criticism of particular installations (Frolova and Pérez Pérez 2008; Prados 2010; Prados et al. 2012).

The implications of renewable energies on landscape were explored in a report entitled 'Landscape and Wind Turbines' presented to the 6th Council of Europe Conference on the European Landscape Convention (Council of Europe 2011). The objective of this report was to produce general guidelines for the member states to help bring about the integration of wind power into the landscape. The report avoided setting out any one specific methodology, so that its recommendations could be applied in all member states. According to this report, effective wind power planning must identify exclusion areas according to technical (network connection, wind energy potential, noise, etc.) and biological criteria (protection of bird and bat species) and then select suitable areas in terms of wind, infrastructure and landscape conditions.

Thus, the correct planning of renewable energies requires an analysis that approaches the issue from various different perspectives: social, environmental, economic, spatial planning, etc. This integrated analysis can be conducted using GIS, a powerful geographical analysis tool which is capable of processing and generating information that provides extensive knowledge of the territory, thanks to built-in features for the capture, search, management, analysis and output of geographical data.

Given these characteristics and the possibility of combining them with other techniques, it is hardly surprising that GIS are now frequently used in planning and decision-making. They have also been applied in the field of energy and, particularly, renewable energies, where they have proved useful in both the deployment of the energy system, from initial planning to site selection (Domínguez et al. 2010).

Over the last 20 years, a wide range of approaches have been applied in the assessment of suitable locations for the installation of renewable energies. Various researchers and institutions have used GIS in conjunction with multi-criteria assessment techniques (MCA) in order to identify the best locations for the deployment of these types of energy at different scales and in different territories (Voivontas et al. 1998; Baban and Parry 2001; Rodman and Meentemeyer 2006; Lejeune and Feltz 2008; Simao et al. 2009; Janke 2010; Cowell 2010).

Although a GIS is clearly a powerful tool, objections have at times been raised linking their use to a negative approach to land use planning dubbed 'negative planning' (identifying areas in which renewable energy plants would not negatively affect any previously defined interests) or to analyses limited by existing administrative boundaries (Shang and Bishop 2000; van der Horst and Lozada-Ellison 2010; Pérez 2010).

Their use in terms of landscape and renewable energy interaction has traditionally involved viewshed, proximity and density analyses of potential sites for wind turbines (Möller 2010), as well as the prohibition of these infrastructures in places of great scenic value or high landscape quality, criteria which can be perfectly addressed through GIS but which must be revised for two main reasons: firstly, because one of the most remarkable advances set out in the European Landscape Convention (Council of Europe 2000) is that all territory should be considered as landscape, no matter how commonly occurring it is, and as such it must be protected, thus going beyond the previously held notion that only exceptional landscapes should be protected, and secondly, because even if visual impact is one of the most important factors giving rise to negative perceptions of wind power (Wolsink 2007), the most commonly used GIS methods (known as 'viewshed analysis') offer only a limited representation of the true individual human experience (van der Horst and Lozada-Ellison 2010).

The objective of this research is to analyse the use of GIS in the planning and management of wind farms in Spain, setting out the advantages and disadvantages of using these tools to facilitate the territorial and landscape integration of wind power infrastructures.

For this purpose we conducted a comparative analysis of different experiences of wind farm planning in Spain conducted using GIS at different scales, concentrating above all on the methodologies that were applied. We then focused on two case studies using GIS and renewable energies in Spain, in which cooperative decision-making and public participation in the wind farm installation process was promoted, both necessary elements for improving the integration of these infrastructures into the landscape (Frolova 2010). These experiences can now be built on and developed, thanks to improvements in the dissemination of and access to geographical information.

15.2 Using GIS in the Identification of Suitable Sites: The Case of Wind Power in Spain

In the case of Spain, location assessments aimed at identifying the optimum sites for wind power installation have been conducted at national, regional and subregional levels, although planning has only taken place mainly at regional level. This is due above all to the fact that the deployment of wind energy in Spain is subject to national government policy, although decisions regarding changes in zoning schemes are taken at regional level (Frolova 2010). This can lead to planning problems in that in order for landscape to be properly assessed in wind energy planning, studies must be conducted at all spatial levels. We will now go on to tackle these issues by analysing some of the experiences in Spain at each different scale, paying particular attention to the methodology they applied, their use of geographical information systems and the consideration of territory and landscape in their analysis.

15.2.1 Experiences at a National Level

At a national level, there is only one official planning document in which GIS and MCA techniques were used to identify both exclusion zones and suitable areas for the installation of wind farms in Spain: *Strategic Environmental Study of the Spanish Coastline for the Installation of Marine Wind Parks* (*Estudio Estratégico Ambiental del Litoral Español para la instalación de parques eólicos marinos*), which was approved in April 2009 (Ministerio de Industria, Energía y Turismo y Ministerio de Medio Ambiente, Medio Rural y Marino, 2009).

The objective of the *strategic study*, carried out by the Spanish Ministry of Industry, Tourism and Commerce, was to determine those areas within the public maritime and terrestrial domains which, environmentally speaking, offered favourable conditions for the installation of offshore wind farms.

This official study identified two kinds of impact: environmental impact and impact on strategic territorial elements, all of which were treated using GIS. Seventy-two marine wind areas were identified and divided into three categories: ‘exclusion areas’, ‘suitable areas with environmental constraints’ and ‘suitable areas’.

Exclusion areas were defined according to the following criteria:

- Areas located between the coast and an imaginary line marking a bathymetric level of 10 m, in order to reduce the effects on coastal dynamics
- Protected natural spaces and sensitive areas (areas with endangered species, fields of Mediterranean tapeweed or other spermatophytes) and a 1-mile peripheral protection area around them
- Coastal wetlands and a 6-mile protection and buffer zone from the coastline around them, in order to guarantee conservation of the main bird migration routes along the coast
- Heritage areas or underwater archaeological sites that have been declared *Sites of Cultural Interest*
- Approach and take-off areas for air traffic and main shipping routes
- Fishing grounds
- Oil drilling and aggregate extraction areas
- Scientific research areas
- Subterranean petrol and gas pipelines and submarine cables and the space required for their maintenance

Once these areas were excluded, the *strategic study* established the areas considered as ‘suitable albeit with constraints’ as those in which further examination of the environmental impact assessment of wind projects was required.

The remaining areas were classified in the document as suitable for the installation of wind energy projects, although the final decision would be taken in the local environmental impact assessment for each project, in accordance with *Royal Legislative Decree 1/2008*, through which the amended text of the Law for the Assessment of the Environmental Impact of projects was approved.

Although this document offered an initial estimate of Spain's nationwide potential for the deployment of offshore wind power, it aroused some criticism in that it implemented a zoning system based on geographical grids which did not match the specific territorial reality of the population living adjacent to the coast (Pérez 2010). Another drawback was that it was conducted at a level at which it was impossible to address more local criteria, such as landscape and social perception, two major reasons for the rejection of wind power by both the general public and conservationist organizations.

An analysis of similar documents issued at a regional level reveals that in general they do not take landscape criteria into consideration when assessing suitable sites for wind power, apart from prohibiting the installation of turbines in places of outstanding scenic or natural beauty. They also reveal the need to establish local scale tools that take into account criteria that cannot be considered at regional or national level.

15.2.2 Experiences at a Regional Level

At a regional scale, several Spanish autonomous communities have already devised wind energy plans using GIS and MCA techniques. A list of these plans can be seen in Table 15.1, which also includes the current spatial planning documents for each autonomous community.

In some regions (Valencia, Cantabria and Galicia), specific guidelines and plans for wind power deployment were devised before it was considered in regional spatial planning. As a result, sustainable, coherent, spatial planning has not been achieved, because wind power planning was carried out from a limited sectorial standpoint on the basis of strategic plans with no real territorial dimension or by executing a series of emblematic projects (Hildebrand 2006).

In general terms, the combined use of GIS and MCA techniques has proved a very useful tool in drawing up these plans, despite a lack of coordination in both the methodology and the regional guidelines and planning of all issues related with and influencing wind energy production (Spatial Planning, Industry, Environment, etc.).

All the plans establish exclusion areas in which wind farms may not be installed. These are identified mainly through a series of criteria, which for the most part are common to all the different regions, such as the existence of protected natural spaces, increased biodiversity, cultural interest, woodlands, distance to population centres and minimum wind levels, although the degree of restriction applied varies from one plan to the next. In Catalonia, for example, wind energy development is not permitted in any protected natural areas, irrespective of the category to which they belong, whereas in the Basque Country and Galicia, a protected area categorized as a Place of Importance for the Community (LICS) or a Special Protection for Birds Areas (ZEPAS) would only be excluded after a specific study of the area had been conducted.

In the case of Galicia, Cantabria, the Basque Country, Castile Leon and Valencia, wind zoning plans were based on a previous study of winds in the region, so that later they would only have to study the suitability of territories with a high wind

Table 15.1 Wind energy plans and spatial planning in autonomous communities of Spain

Autonomous communities of Spain	Wind energy plan	Spatial planning
Galicia	Galicia Wind Power Sector Plan – Plan Sectorial Eólico de Galicia (1997)	Territorial Planning Guidelines – Directrices de Ordenación del Territorio (2011)
Valencia	Valencia Region Wind Power Plan – Plan Eólico de la Comunidad Valenciana (2001)	Valencia Region Territorial Strategy – Estrategia Territorial de la Comunidad Valenciana (2011)
Basque Country	Basque Region Wind Energy Sector Territorial Plan – Plan Territorial Sectorial de la Energía Eólica de la CAPV (2002)	Basque Country Territorial Planning Guidelines – Directrices de Ordenación territorial de la Comunidad Autónoma del País Vasco (1997)
Catalonia	Sector-based Territorial Plan for the Deployment of Wind Energy in Catalonia – Plan Territorial Sectorial de la Implantación de la Energía Eólica de Cataluña (2002)	Catalonia General Territorial Plan – Plan Territorial General de Cataluña (1995)
	Plan for the identification of priority development areas for the installation of wind farms in Catalonia – Plan de determinación de zonas de desarrollo prioritario para la implantación de parques eólicos en Cataluña (2012)	
Asturias	Sector-based Guidelines for Territorial Planning for the Exploitation of Wind Energy – Directrices Sectoriales de Ordenación del Territorio para el aprovechamiento de la Energía Eólica (2008)	Regional Territorial Planning Guidelines – Directrices Regionales de Ordenación del territorio (1991)
Cantabria	Environmental strategy for the exploitation of Wind Energy in Cantabria within the framework of the Cantabria Energy – Plan Estrategia ambiental para el aprovechamiento de la energía eólica en Cantabria en el marco del Plan Energético de Cantabria (2008)	Regional Territorial Plan (currently being drawn up) – Plan Regional de Ordenación Territorial (in press)
Castile La Mancha	Castile-La Mancha Wind Energy Plan – Plan eólico de Castilla La Mancha (2011)	Strategic Territorial Plan ‘Territorial Strategy for Castilla La Mancha’ (currently being drawn up) – Plan Ordenación del Territorio ‘Estrategia Territorial de Castilla La Mancha’ (in press)
Castile Leon	Castile -Leon Wind Energy Plan. Documents for the 9 provinces – Plan eólico de Castilla-León. 9 Documentos provinciales (1999–2000)	Castilla-León Essential Territorial Planning Guidelines – Directrices Esenciales de Ordenación del Territorio de Castilla y León (2008)

potential. Even though this approach allows for a more detailed analysis of high-potential areas, the main drawback is that advances in wind power technologies and systems may mean that some areas with apparently little potential become viable in the future, and there would be no data for assessing the environmental impact of projects in these areas.

Other regional plans have selected specific locations for the installation of wind energy plants. This is counterproductive in large autonomous communities, such as Valencia and Castile Leon, where no proper landscape studies have been carried out to establish specific areas for wind power implementation. At such a large scale, it is virtually impossible to perform a detailed analysis of the different landscape criteria or indeed of any other type of criteria at each individual site. As a result almost all of these plans have attracted negative criticism from conservationist and citizens groups worried about their impact on landscape and heritage and other environment-related aspects.

15.2.3 Experiences at a Subregional Level

There are relatively few cases in which locations for wind power deployment have been planned and assessed at a subregional or local level in Spain. Two examples which stand out due to their special methodology are the Special Supramunicipal Plan for the Organization of Wind Energy Infrastructures in La Janda Area (*Plan Especial Supramunicipal de Ordenación de Infraestructuras de los recursos eólicos en la Comarca de la Janda*) (ARE 2004a) and the Special Plan for the Organization of Wind Energy Resources in Jerez de la Frontera (*Plan Especial de Ordenación de los recursos eólicos de Jerez de la Frontera*) (ARE 2004b). Furthermore, these were the first plans in Spain to assess the impact of these infrastructures on the landscape and the environment (Frolova and Pérez Pérez 2011).

As in the other cases described above, the combined use of GIS and MCA techniques proved an essential tool for assessing the potential for wind farm deployment. It is worth mentioning that identical methodologies were used for the wind farm plans in La Janda and Jerez de la Frontera, both based on the analysis of the main variables that must be considered for the regulation of wind power deployment (wind farm potential for the region, decisive technical factors, studies of physical space, landscape assessment, ornithological studies, etc.). Their objective was to regulate the installation of the necessary transport and transformation infrastructures required to feed the energy produced by new wind plants into the grid (not included in any of the previous plans).

They therefore began by conducting a wind study to estimate the gross wind power potential and then analysed the limitations imposed by vegetation, fauna, population, economic activities, lithology, physical factors, urban planning, natural spaces and landscape.

The plan established three types of area, namely, exclusion areas, areas considered compatible subject to certain conditions and areas not subject to specific determining factors, generally considered suitable for wind power deployment. They classified as exclusion areas those considered to be of high environmental quality or fragility or in which wind power development could compete with or harm other socioeconomic activities or negatively affect their environmental, urban and landscape characteristics. Other areas were classified as suitable subject to certain conditions, in which it was necessary to demonstrate the compatibility of wind power projects with the surrounding environment, while in the remaining areas, energy companies would be free to install plants and would only be subject to the general procedures established in local environmental impact guidelines and other applicable municipal legislations.

These plans also forced developers of wind farm projects to present joint planning and integration proposals for the area and to share power transmission infrastructures in order to keep their environmental and landscape impact to a minimum.

Landscape resources were studied in both plans by creating an inventory which identified the particularities of the landscape and other important features. Viewsheds and made 3D visual simulations were also analysed, as was the way landscape is perceived from population centres, commonly frequented itineraries (roads etc.) and scenic points.

These analyses showed just how important GIS are for location assessment. Having said this, it is important to make clear that before using them for wind power planning, it is necessary to develop a referential conceptual framework for the use of this energy, since otherwise GIS would not fulfil their role in the development of a rational, integrated planning model for renewable energies.

15.2.4 Proposal of a Referential Conceptual Framework for Wind Farm Planning

Our analysis of different experiences of wind energy planning using GIS has shown the need to establish a reference framework prior to using the tool. For effective wind farm zoning, various territorial and landscape factors must be considered in the installation of each project, including the particularities of each territory in terms of useful resources for wind energy and the character of each landscape (those elements or attributes that make it unique) (Díaz et al. 2010). In addition, general criteria for the selection of locations can and must be established, since the size of the investment and the environmental/territorial effect of each intervention require the development of a highly detailed project that foresees and analyses all its repercussions, including a complete and accurate territorial contextualization. This will require analysis at different spatial scales for a number of reasons.

This is firstly because the use of different scales is sometimes of key importance for understanding a particular situation in all its complexity, above all in the context of an increasingly interdependent world. As an example, the installation of a particular infrastructure may have a balancing or unbalancing effect depending on the scale at which it is studied (Gutiérrez 2001). These seemingly contradictory views are in fact complementary and can give us a clearer understanding of the situation.

In the case of wind power, at regional level, it would be more efficient in technical and economic terms to concentrate wind farms in a given area, and this would minimize their impact at a regional level by sharing common infrastructures. However, it would also concentrate the impact at a local level, resulting in highly imbalanced deployment compared to other towns and villages that do not have such installations.

Secondly, because even though problems at a local scale can be addressed more effectively through local action, it is essential to look beyond the strict immediate scope of the study, so avoiding the risk of viewing the territory in question in isolation, which would be a serious mistake (Zoido 1998).

Thirdly, because shifts in scale uncover certain differences and aspects which are hidden from view in the preceding scale, and which can be enormously enriching, while in the opposite case, according to Harvey (2003), if we analyse all aspects of a problem at a single scale, the results will be unreliable, if not misleading.

For these reasons, it is clear that wind farm site selection requires a detailed assessment of the territory, which can be carried out almost entirely using GIS applied at different territorial scales.

The effective use of GIS for establishing coherent wind farm zoning also requires previous identification of the elements, criteria, contents and methods that must be focused on at each scale. All of these must be linked, on the one hand, to component aspects and operational factors in each spatial dimension and, on the other, to political competencies, administrative organization and planning at each territorial level (Zoido 2001).

Thus, at a regional scale, the generation of location models for wind farm zoning using GIS must seek to establish a referential territorial framework, which identifies the territories with environmental, physical, efficiency and public health-related limitations for the deployment of wind power. In no case must these result in the selection of specific areas for installing wind farms, since this would entail taking decisions about non-defined realities, given that we cannot know where the final projects will be installed and what they will be like (Pérez et al. 2007) and because some of the criteria that must be considered (wind resources, impact on bird species or landscape, etc.) cannot, due to their nature, be properly and fully addressed at a regional scale, particularly in large territories.

Work at a regional scale must also identify those areas that must be studied in more detail at a subregional level. Subregional studies should include the analysis of criteria not addressed in the regional model, such as landscape criteria and public perception, as well as a more detailed analysis of other criteria already considered at the higher scale.

GIS models built at a local or project scale must seek to identify the most suitable locations for wind farms. This must be done coherently with regional and subregional models, and establishing the optimum distribution of the different elements in the wind farm must be tried in order to bring about or at least improve its integration into the landscape, at times even pinpointing the exact location of the installation and the wind turbines.

15.3 GIS for Territorial and Landscape Analysis: Viewers Generation- Geodatabase of renewable Energy in Andalusia. Identification of wind power landscapes in Andalusia

The great analytical capability of GIS is well known, and the improvements in recent years in the access to and dissemination of spatial data, the implementation of geographical databases and spatial modelling and the rapid development of GIS applications have further increased their analytical possibilities. We now present some examples of how improvements in these systems are providing an even more exhaustive knowledge of territories and landscapes.

15.3.1 An Improvement in the Access to and Dissemination of Geographical Data: Viewers Generation

In essence, an information system is data structured and stored in such a way that, via various consultation methods, users can obtain a response to a request for information. However, user access has become an important bottleneck preventing these systems from providing this service to the largest possible number of users (Ojeda and Cabrera 2006).

In the last few years, great advances have been achieved at a European level in the access and dissemination of geographical information. The transposition of the INSPIRE (2007/2/CE) Directive in Spain and the passing of Royal Decree 1545/2007 regarding the National Cartographic System have enabled the development of the Spanish Infrastructure of Spatial Data (http://www.idee.es/), which allows access to and management of groups of data and geographical services through the Internet (described through their metadata). This system complies with a series of norms, standards and specifications which regulate and guarantee the interoperability of geographical information, thereby promoting its use by the general public and providing easy access to the data it contains.

Despite the advances in access to information, thanks to the transposition of the INSPIRE Directive, in most cases, users must have a 'minimum' technical qualification to access this data. This is why a large part of GIS research in recent years (Serra 2002; Metternicht 2006) has been focused on methods and tools to improve data access and dissemination.

With this in mind, the Coastline Planning and Territorial Information Technology research group from the University of Seville has been working on a project to develop geographical viewers for coastal areas. The objective was to make a viewer that was easily consulted (interactive tactile viewer) and accessed (through web browsers) by the general public, whether they be general or technical users.

Fig. 15.1 3D view of the Buena Vista wind farm (Barbate, Cádiz) in the viewer designed by the research group from the University of Seville

These tools have enabled the design of a variety of useful applications for the planning and management of renewable energies, including the simulation of their impact on the landscape, using 2D, 2.5D and 3D (Fig. 15.1) viewing tools, as well as other features such as visibility analysis, interactive flights, etc.

These functionalities are highly valued both by specialists and by the general public, as they allow non-expert potential users to view elements of the terrain from a more familiar perspective, thus enabling the participation of local stakeholders, which will ultimately lead to an improvement in the governance of these spaces.

15.3.2 Generation of a Renewable Energy Geodatabase in Andalusia: Wind Farm Landscapes in Andalusia

The development of the National Aerial Orthophotography Plan (PNOA), a project coordinated by the National Geographic Institute (IGN) and the National Geographical Information Centre (CNIG), provided digital orthophotographs of the whole country. These included data obtained from photogrammetric flights, field support, aerial triangulation and digital elevation models. The project is in constant evolution and is updated every 2 years in line with user needs and technological developments.

In the case of Andalusia, these orthophotographs are available as Web Map Services at the spatial data infrastructure (SDI) node for Andalusia (http://www.ideandalucia.es) and are easily viewed through any GIS software or viewer. This advance in the access to spatial information can also be applied to the case in hand – GIS and renewable energies – in that we can now access spatial information about renewable energy power plants installed in the autonomous community of Andalusia via the photointerpretation and digitalization of a series of aerial photographs from 1998, 2002, 2004, 2006 and 2009.

In this way, all the wind turbines and the areas covered by solar plants in Andalusia have been digitalized. Spatial information about biomass and mini-hydraulic power plants has also been compiled. All this spatial data has been gathered from information provided by a variety of energy-sector sources – the Wind Energy Producers Association and the Photovoltaic Industry Association and the Andalusian Energy Agency, amongst others – and has allowed us to characterize each plant according to data about the installed power, the name and height of the wind turbines, etc. All this data about renewable energy power plants has been entered into a geographical database together with the spatial information showing municipal and regional boundaries, landscape types and other details. The database can be easily consulted through simple SQL (structured query language) queries, permitting the dynamic generation of a large number of indicators for renewable energies.

The result of this work is a powerful geographical database on renewable energy in Andalusia, which will be of great interest for the analysis and management of these installations. The use of the geographical database will not only mean an improvement in the results of previously performed analyses but will also enable the generation of new indicators of great landscape and territorial importance, such as the density of wind turbines by municipality or landscape unit. In Andalusia the town with the highest density of wind turbines is Tarifa (Cádiz), with 1.51 wind turbines/km^2. Other indices we calculated include the location of solar plants and the area they occupy (275 plants, covering a total area of 2.309,7) and the number of wind turbines located inside protected natural spaces (360).

Another example of a key indicator obtained using the spatial database described above was the calculation and identification of the area of Andalusian land that has undergone landscape changes as a consequence of the installation of wind farms, on the basis of the criteria established by De Andrés and Iranzo (2012), who identified what are known as wind power landscapes.

Our aim was to perfect this analysis and apply it in Andalusia, since information as to the exact location of each wind turbine and its altitude was already available in the turbine specifications. In our analysis we also took the influence of topography into account, by applying the 1:10,000 Digital Elevation Model, the DEM with the highest resolution and hypsometric accuracy in the region, which is composed of a 10×10 dot regular mesh of planimetric resolution.

In this way, we were able to identify the areas visible from each wind turbine. To achieve this, we performed a series of visibility analyses from wind turbines using GIS, in this case the ESRI Arc-GIS viewshed module together with the model builder tool. This is also part of ESRI software applications, through which a large number of spatial analysis operations can be carried out easily and efficiently.

After operating the GIS and processing the information on areas of influence (those visible up to a distance of 15 km) around the wind turbines installed in

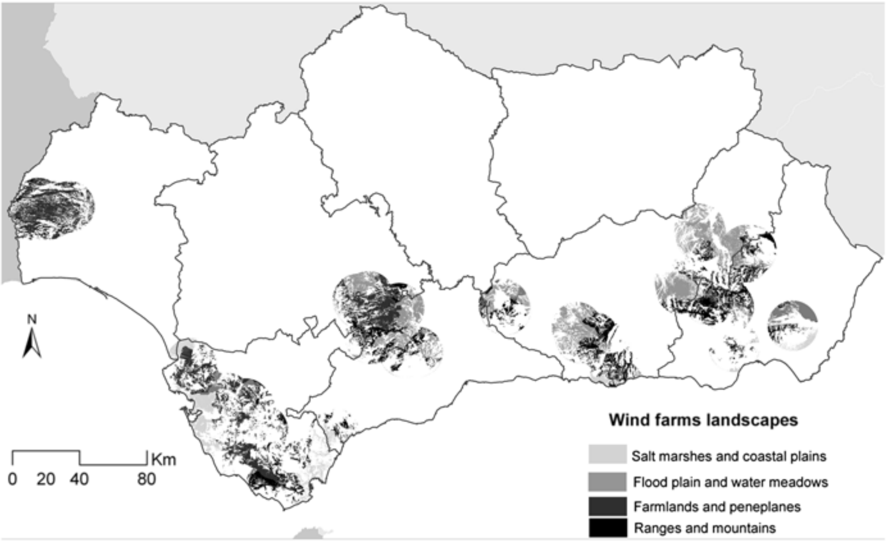

Fig. 15.2 Wind farm landscapes in Andalusia, 2009

Andalusia, we then cross-referenced this information with the Atlas of Spanish Landscapes (Mata and Sanz 2004), which identifies and characterizes landscapes in the Iberian Peninsula and the Spanish islands. The results can be seen in Fig. 15.2.

This shows that the location of wind farms in one province can have landscape repercussions on adjacent land in neighbouring provinces. This also happened in cross-border areas between Spain and Portugal, where the wind farms located in the Andévalo region of the province of Huelva affected certain adjacent Portuguese landscapes.

Wind power plants were also shown to have landscape implications for some of the region's protected natural spaces, in which although spatial planning prohibited the installation of wind farms, their deployment in the immediate vicinity would have evident impacts on the landscape.

Finally, with regard to the affected area, and ignoring any obstacles arising from the presence of buildings or other elements that might hide or reduce visibility of some of the wind turbines, the installation of wind farms has brought about important landscape changes affecting a total of 6,528 km^2, about 7.4 % of the surface area of Andalusia.

15.4 Conclusion

When used in conjunction with multi-criteria evaluation techniques, GIS are excellent tools for the identification of suitable areas for the installation of renewable energy plants. Research on this question in Spain has shown the great potential of this tool. Nevertheless, in order to take full advantage of its functionalities, it is necessary to establish a referential conceptual framework for each of the renewable energies before GIS can be used at each scale and for each territory. This conceptual framework should establish the contents and criteria that must be taken into account in each location model built using GIS. These criteria must be defined by the authorities responsible for territorial and landscape quality, who must take the opinion of local stakeholders into account. In the case of landscapes, these criteria must not be limited to mere visibility analysis or the prohibition of renewable energy plants in scenic landscapes and must include public perception and participation, given that landscapes are dynamic and changing both in their configuration and their social requirements.

To this end, the recent technological developments and advances in production and access to spatial information have permitted the gathering of information of great interest for the assessment of the implications of these energies on different areas and landscapes. From this perspective, digital technology and 3D geovisualization can be used to create a virtual visual environment which accurately reproduces the real situation and is especially useful in applications relating to territorial and environmental management or in constructing tools that enhance public participation. There are also increasing demands from the Internet environment and from general users for the development of visualization tools that are easy to use (viewers).

In this sense, Spain continues making major efforts to implement a spatial data infrastructure and to produce standardized, interoperable services and data which have a positive impact on the availability of geographical information and, therefore, on the creation of new indicators that can help improve spatial and landscape planning of renewable energy.

References

ARE, Arenal Grupo Consultor, S. L. (2004a) Plan Especial Supramunicipal de Ordenación de los Recursos Eólicos de la Comarca de la Janda. Cádiz, Spain

ARE, Arenal Grupo Consultor, S. L. (2004b) Plan Especial de Ordenación de los Recursos Eólicos de Jerez de la Frontera. Cádiz, Spain

Baban S, Parry T (2001) Developing and applying a GIS-assisted approach to locating wind farms in the UK. Renew Energy 24:59–71

Council of Europe (2000) European Landscape Convention http://conventions.coe.int/treaty/fr/Treaties/Html/176.htm. Accessed 30 Sept 2013

Council of Europe (2011) Landscape and wind turbines. 6th Council of Europe Conference on The European landscaoe Convention http://www.coe.int/t/dg4/cultureheritage/heritage/landscape/reunionconf/6econference/CEP-CDPATEP(2011)11_en.pdf. Accessed 30 Sept 2013

Cowell R (2010) Wind power, landscape and strategic, spatial planning. The construction of 'acceptable locations' in Wales. Land Use Policy 27:222–232

De Andrés C, Iranzo E (2012) Desarrollo de las energías renovables y cambios paisajísticos: propuesta de tipología y localización geográfica de los paisajes energéticos de España. In: Gozálvez V, Marco JA (eds) Energía y territorio: dinámicas y procesos. XXII Congreso de Geógrafos Españoles. Universidad de Alicante, Alicante, pp 97–107

Díaz P, Rodríguez J, Zoido F (2010) Energías Renovables y Paisaje. In: Izquierdo JM (ed) Energías Renovables: Paisaje y Territorio Andaluz. Grupo de Estudios Avanzados Sobre Territorio y Medio Ambiente Textura, Sevilla, pp 83–101

Domínguez J, Lago C, Prades A, Díaz P (2010) Energías renovables y modelo energético. Una perspectiva desde la sostenibilidad. Nimbus. Revista de Climatología, Meteorología y Paisaje 25–26:42–43

Espejo C, García R (2012) La energía eólica en la producción de electricidad en España. Rev Geogr Norte Gd 51:115–136

Frolova M (2010) Los paisajes de la energía eólica: su percepción social y gestión en España. Nimbus Revista de Climatología, Meteorología y Paisaje 25(26):93–110

Frolova M, Pérez Pérez B (2008) El desarrollo de las energías renovables y el paisaje: Algunas bases para la implementación de la Convención europea del paisaje en la política energética española. Cuadernos Geográficos 4:283–309

Frolova M, Pérez Pérez B (2011) New landscape concerns in development of renewable energy projects in South-West Spain. In: Landscapes, identities and development. Ashgate Publishing, Farnham, pp 389–401

Gutiérrez J (2001) Escalas espaciales, escalas temporales. Estudios Geográficos 62:89–104

Harvey D (2003) Espacios de esperanza. Akal, Madrid

Hildebrand A (2006) La política de ordenación del territorio de las Comunidades Autónomas: balance crítico y propuestas de mejoras de su eficacia. Revista de Derecho Urbanístico y Medioambiente 230:79–139

Janke J (2010) Multicriteria GIS modeling of wind and solar farms in Colorado. Renew Energy 35:2228–2234

Lejuene P, Feltz C (2008) Development of a decision support system of setting up a wind energy policy across the Walloon Region (southern Belgium). Renew Energy 33:2416–2422

Mata R, Sanz C (2004) Atlas de los paisajes de España. Ministerio de Medio Ambiente FEDER, Madrid

Metternicht G (2006) Consideraciones acerca del impacto de Google Earth en la valoración y difusión de los productos de georepresentación. Geofocus 6:1–10

Ministerio de Industria, Energía y Turismo y Ministerio de Medio Ambiente, Medio Rural y Marino (2009) Estudio Estratégico Ambiental del litoral español para la instalación de parques eólicos marinos. Gobierno de España

Möller B (2010) Spatial analyses of emerging and fading wind energy landscapes in Denmark. Land Use Policy 27:233–241

Ojeda J, Cabrera A (2006) Utilidades y funcionalidades de un visor tridimensional interactivo en la gestión litoral (SIGLA: Sistema de Información Geográfica del Litoral de Andalucía). Cuadernos Geográficos 39:41–52

Pérez B (2010) Perspectivas de desarrollo y ordenación territorial y paisajística de la energía eólica offshore en España. Nimbus Revista de Climatología, Meteorología y Paisaje 25(26):175–186

Pérez B, Requejo J, Ballesteros C (2007) Energías Renovables y Paisaje: Incidencia en el Paisaje de Parques Eólicos y Plantas Fotovoltaicas. Escalas de Análisis. In: Agua, Territorio y Paisaje. De los instrumentos programados a la planificación aplicada. FUNDICOT V CIOT, Málaga, pp 1191–1204

Prados MJ (2010) ¿Energías renovables o agricultura? Un análisis de la percepción ciudadana sobre huertos y latifundios solares en Andalucía. Nimbus Revista de Climatología, Meteorología y Paisaje 25(26):205–229

Prados MJ, Baraja E, Frolova M, Espejo C (2012) Integración paisajística y territorial de las energías renovables. Ciudad y territorio: Estudios territoriales 171:127–143

Rodman L, Meentemeyer R (2006) A geographic analysis of wind turbine placement in Northern California. Energy Policy 34:2137–2149

Serra P (2002) Alternativas a los servidores de mapas. Mapping 80:14–20

Shang H, Bishop I (2000) Visual thresholds for detection, recognition and visual impact in landscape settings. J Environ Psychol 20(2):125–14

Simao A, Densham P, Haklay M (2009) Web-based GIS for collaborative planning and public participation: an application to the strategic planning of wind farm sites. J Environ Manage 90(6):2027–2040

van der Horst D, Lozada-Ellison LM (2010) Conflictos entre las energías renovables y el paisaje: siete mitos y la propuesta de manejo adaptativo y colaborativo. Nimbus Revista de Climatología, Meteorología y Paisaje 25(26):231–251

Voivontas D, Assimacoupoulus D, Mourelatos A, Corominas J (1998) Evaluation of renewable energy potential using a GIS decision support system. Renew Energy 13:333–344

Wolsink M (2007) Wind power implementation: the nature of public attitudes: Equity and fairness instead of 'backyard motives'. Renew Sust Energ Rev 11:1188–1207

Zoido F (1998) Geografía y ordenación del territorio. Geografía e Historia 16:19–31

Zoido F (2001) La ordenación del territorio a distintas escalas. In: Geografía de España. Ariel, Barcelona, pp 505–618

Index

M. Frolova et al. (eds.), *Renewable Energies and European Landscapes*,
DOI 10.1007/978-94-017-9843-3