

## Article

# Nature of the Wind, the Culture of the Landscape: Toward an Energy Sustainability Project in Catalonia

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**Abstract:** Landscape and energy are an inseparable and innovative binomial because of the challenges they imply and being the factors we use to measure the quality of our habitat. Presenting the report “Wind Energy and Landscape. Guidelines for a suitable installation in Catalonia”, which involved research into the methodology for installing wind farms, this article presents a critical reflection on the possible spatial, ethical, and aesthetic effects of energy transition. Landscape design interprets the convergence of territorial values with the innovation of an energy system: it is not measured on a geographical scale, but draws from geography the sense of the overwriting of everyday places, giving them sense, orientation, meaning, and narrative. The research involves ecology, society, nature, and culture. Methodologically, the approach is reversed: rather than designing a project for the correct installation of wind power plants, the project for the wind landscape is understood as new contemporary nature. Wind energy and the culture of the landscape legitimize an advance in thought on design tools, espousing the dictates of the *European Landscape Convention* and more recent ambitious goals set by the *UN* with the *2030 Agenda*.



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**Keywords:** wind energy; landscape design; cultural sustainability; contemporary nature; social perception; Catalan energy transition policies; European Landscape Convention; 2030 Agenda

## 1. Introduction

### 1.1. Toward Sustainable Landscapes

The ongoing green transition is configuring energy landscapes through the indifferent overwriting of territories [1]. Renewable energies have produced a sudden and strong transformation of the landscape due to their positioning in areas with visual exposure and their considerable symbolic significance. Relating energy and landscape, therefore, means considering the complexities of a reaction between different identities and values. This is impossible to manage in using a mechanical and consequential method because performance issues are measured against the cultural, identity, and emotional values of a place [2,3].

Landscape and energy are an inseparable and innovative binomial because of the impacts of the transition and because they are the factors we use to measure the quality of our habitat. The challenge lies in implementing a conceptual reversal from an energy project directed at a territory to a territory requesting a landscape design.

By operating on the material, perceptive, and intangible aspects of the interface between the installation of the system and its surroundings, the logic, the structural aspect, and the matrix of the energy configuration are found in the landscape. Thus, the spatial repercussions of the new energy supply can determine the added value to landscape quality, being defined as actions and processes that reconnect human transformations to environmental systems.

The use of renewable energy sources is strongly promoted by Europe [4], but what is less clear is how wind turbines might be best integrated into the territory considering

criteria other than those linked only to the most efficient wind collection. A more articulated assessment of this issue is needed that does not express facile and hostile attitudes in the name of safeguarding our landscape heritage, which are generated precisely by the lack of alternative criteria [5–7]. If the wind turbines have an adequate dialogue with the landscape, the central question is not how high a price is paid by the landscape, but how the absence of the project is much more burdensome.

Working in the landscape and with the logic of the landscape to promote energy strategies as new forms of nature is the contemporary challenge for more conscious and informed and, therefore, truly sustainable projects [8].

This paper presents a critical reflection following research conducted on new design criteria for wind energy infrastructure that is capable of expressing an attitude of approach and symbiosis between sustainable technology and landscape values.

The field of study is Catalonia, a cutting-edge, advanced country, with a complex and articulated territory that is undergoing a delicate energy transition phase. Implementation tools for renewables are still lacking due to an inability to understand energy landscapes as an innovative strategy that prioritizes the landscape project that best qualifies the landscape over the performance aspect of the installations [9–11].

The aim of this study was to advance the thought on design tools through new guidelines that espouse the dictates of the European Landscape Convention (ELC) [12] and the more-recent ambitious goals set by the United Nations (UN) with the 2030 Agenda, and experiment with suitable solutions for a wind landscape as an identity product of the territories in which they are installed.

The Catalan Government commissioned the Landscape Observatory of Catalonia, a critical and propositional study, to establish sensitive criteria for the specific planning and installation of new wind turbines. The report titled “Wind Energy and Landscape. Guidelines for a suitable installation in Catalonia” [13] was composed by an international and interdisciplinary research group formed by Pere Sala i Martí (environmental scientist), Daniela Colafranceschi (landscape architect), Jordi Grau (environmental scientist), Fabio Manfredi (landscape architect), and Sergi Saladié (geographer).

This report is based on a background of documents, studies, addresses, experiences on best practices, and policies implemented to date in Europe as a cultural reference, in the anachronistic impossibility of referring to totalizing theories or empirical research that can codify univocal methods of intervention on the landscape.

The research falls within the experimental characteristics of a methodology applied to the Catalan context, which introduces elements of innovation into the sustainable relationship between transformations and society to provide a guidance tool.

Our position is to conceptually overturn the assumption: a study not directed toward the integration of renewable infrastructure into the landscape, but, accepting the challenge of broader responses, based on the design of ecological and sustainable landscapes as a new form of nature based on the decentralization and energy redistribution, on the increased involvement of local communities in terms of co-participation, and on knowledge and awareness of the population. We have the conviction that beyond the performance value of the infrastructure, a wind farm can respond to the need for a project for new landscapes by emancipating the meeting point between environmental, technological, ecological, and social values to the point of constructing new identities [14–16].

How can we bring the logic of the wind farm closer to that of landscape and identify a structure that is not only compatible, but also combines both entities in the search for a condition of harmony and quality of habitat? How can we express the social perception value and ecological awareness of a wind farm as a construction of a different and new-identity sustainable landscape that substantiates ecology and society, nature and culture? Above all, how can it be explained? In other words, how can we find the most suitable form of expression that is easy to transmit and communicate within an instance of critical awareness and environmental sustainability?

These are the questions that substantiated this research.

## 1.2. Cultural Context of Reference

In 2015 the UN, through the 2030 Agenda, set new ambitious goals for sustainable development contained within 17 objectives and 169 targets to be achieved in a future that has connotations for the present: an implementation and propositional program that calls for global sustainability—economic, social, and environmental—to be actioned immediately.

The United Nations is calling for a response to a global issue, the environmental emergency, paying due attention to the locality, territory, people, and to the landscape that will be impacted by the results of the endeavors.

The transition to sustainability, involving the energy transition aimed for by the UN countries, will impose radical and far more significant changes on the territory than those induced by our current sources of energy provision.

The supply of energy, for example, has been discreetly hidden and concealed until recently. As stated by Dirk Sijmons:

our gas flowed silently underground and petrol flowed effortlessly from the pump. Electricity generation was only visible as a plume of smoke on the horizon. The energy endowment of our territories was thus largely silent and we managed to maintain the illusion that our use of energy did not radically change our landscape [17].

New energy sources, such as those linked to wind power, have an above-ground visibility and progressive impacts on the territory, so the supply inevitably becomes more visible, audible, and tangible in our daily lives. The renewable energy infrastructure that is shaping the sustainability of our habitat is large size and scale, and its overlaps with the landscape are bound to be more significant.

The energy revolution underway is, therefore, inextricably linked to use of landscape and the alteration of it. The energy transition starting in our territory will, therefore, have a spatial impact that will inevitably alter its form, function, and perception. The energy transition, therefore, is not merely a technical or infrastructure issue, but also a cultural, political, and social one [18,19].

In Europe, the intensive implementation process began in 2000 [20]. In that year, a total of 12,887 MW was produced in the 27 EU member states by renewable energy, representing 2.2% of the total electrical power. Between 2000 and 2020, the annual rate of increase in power has exceeded double-digit percentages.

In this rapidly changing environment, countries have constructed and implemented regulations and plans to guide the process of new installations. Some countries have also developed interesting strategies for integrating wind energy into the landscape or integrated them into general wind energy regulations and planning. The countries with the longest tradition, recognition at the European level, and the strongest voices in this respect are Denmark [21–26], the Netherlands [27], Scotland [28,29], and Ireland [30,31]. In their policies, the landscape always appears as a key element for overcoming the paradox between the social acceptance of the necessity of energy transition and the conflicts around its physical realization on the local scale. Thus, the integration of wind energy into the landscape, especially from a perceptual point of view (considering both visual and cultural effects), has become a key element in ensuring the successful territorial implementation of energy policies. For many years, Scotland and the Netherlands have had a long list of guidelines and other methodologies that aim to ensure the installation of wind energy is compatible with the symbolic, cultural, ecological, and esthetic values of the landscape and avoid, from the outset, the emergence of social conflicts caused by the proliferation of wind energy. Two good examples are the Scottish reports “Siting and Designing Windfarms in the Landscape” [32] and “Guidance for Assessing the Cumulative Impact of Onshore Wind Energy Developments” [33] (Scottish Natural Heritage, 2012).

The experiences of these countries show that the most successful European wind energy implementation initiatives, both in terms of the amount of wind energy installed and social acceptance, are those that have prioritized local communities who have, thus,

participated in the transformation of their landscape. Among these successful experiences, two different models can be distinguished: that of countries such as Ireland or Scotland, where the landscape dimension and the participation of local communities have been an integral part of planning from the outset; and the cases of Denmark, Germany, and the Netherlands, where including local communities in the benefits of the energy produced has been successful. These good practices are based on decentralizing production and empowering local communities. In Denmark, for example, at the beginning of the 2000s, 85% of the wind energy installed in the country belonged to private individuals or wind cooperatives. However, since then, new wind energy implementation targets set by the state government have favored the entry of large wind energy developers, while reducing public policy support for local initiatives. As a result of this change in direction, local opposition to large wind farm projects has increased. This process has also occurred with greater or lesser intensity in other countries.

Thus, in Denmark, Germany, and the Netherlands, cooperatives of small wind turbine owners have played a key role in the dissemination and consensus generation of wind energy from the beginning. The existence of this type of social grassroots organization with entrepreneurial initiative has created a context in which dialogue and consultation between actors are fundamental in wind energy planning on the local scale; conflicts concerning wind energy are absorbed and overcome by majority social acceptance based on the social, landscape, and economic benefits of wind energy. Examples include the REIsland energy self-sufficiency project; Vedvarende Energi [34] for Samsø in Denmark, where a public participation process was adopted for the installation of eleven wind turbines to determine the location criteria (including landscape); or the Wildpolsried das energiedorf [35] in Germany, with seven wind turbines owned, shared by the inhabitants of the country, and located in places that reinforce their perception or singularity.

In these countries, local energy production closer to consumption centers and a commitment to local-scale participation in decision-making processes have provided a favorable framework for energy production. These models not only facilitated community participation in large projects, but also ensured that residents near the wind farms had the right to claim compensation for the loss of value of their property or, otherwise, the establishment of compensation funds to promote local environmental or renewable projects [36].

To emphasize a qualitative rather than a performance-based approach, these proposed models included:

- models and processes of territorial consultation and pacts at the local level;
- models in which the inhabitants and citizens participate in both the location of the projects and the benefits;
- models of decentralized facilities, i.e., located in areas that are already undergoing major changes (infrastructural, industrial, productive, etc.) rather than in sensitive areas with identity or cultural value such as rural or everyday areas.

These guidelines are based on the need to remedy the lack of landscape criteria in the plans for intervention and integration of renewable energy in the territory, in a process that is sensitive to local communities and institutions [37,38]. They are already some avant-garde directives but they still aim to mitigate the impacts infrastructure on the landscape rather than making them a landscape themselves [39–41]. All this only underlines the need for landscape design as the only option capable of meeting these demands.

## 2. Materials and Methods

### 2.1. The Framework for Wind Energy in Catalonia

The report “Wind Energy and Landscape. Guidelines for a suitable installation in Catalonia” is based on the assumption that each landscape expresses specificity and character in the set of elements and factors that are both physical and immaterial, which are specific to it and differentiate it from others. The uniqueness in a territory is demonstrated through relief forms, vegetation, land uses, architecture, heritage, millenary human activity,

perceptions, emotional ties, sense of place, etc., which contribute to differentiating one landscape from another. The term “character” does not denote a static entity: landscapes are dynamic in nature and this dynamism shapes the territory without radically altering it, but maintains visually recognizable characteristics that produce its identity and personality over time.

In this sense, a wind farm builds a new narrative of the productive dimension of the landscape, which appropriates new values and meanings linked to our contemporaneity—and, therefore, to the attitudes and characteristics that belong to our history and our time—to cutting-edge technology, sustainability, the value of producing alternative energy, and to the use of renewable resources. An appropriate balance between landscape and wind infrastructure can help to change people’s common negative perception of wind infrastructure and to generate a good dialogue between all the elements, according to an environmental conscience [42].

In this sense, a wind farm can become a new qualitative habitat reference and an element of territorial identity suited for the future.

To contextualize the research work, we must specify the reasons why we considered this geographical context to construct more appropriate and up-to-date guidelines for the creation of wind parks.

In Catalonia, as in the rest of the developed world, the last few decades have witnessed the start of a full energy transition; within this transition process, renewables, particularly solar and wind power, are decisively important, configuring new production landscapes. However, the development of wind power, even in this geographical dimension, is experiencing a sort of paradox between the acceptance of its effects on a global scale and the rejection, on many occasions, of its impact on the local landscape.

During the 1990s, there were only four wind farms in Catalonia, increasing by two by 2002 [43]. Decree No. 174/2002 of 11 June 2002 aimed to meet 12% of the country’s total electricity production with renewable sources, thus, pursuing the objective of the Plan for Energy in Catalonia, which indicated production values by 2010 of between 1000 and 1500 MW of installed power. Thus, by the first half of 2013, there were 43 wind farms, with an electrical power output of 1272.32 MW produced by 812 wind turbines spread over 43 municipalities and 11 regions; they were highly concentrated territorially, and particularly in the south. This exponential and uncontrolled development led the Generalitat de Catalunya to progressively approve a series of specific measures: the Wind Farm Master Plan (1991–1995 and 1997–2010), the Territorial Sectoral Plan for the Environmental Implementation of Wind Energy (2002), and the Plan for the Determination of Priority Development Zones (ZDP, 2012), as guidelines to assist with this important transition.

The consideration of the landscape entity in the wind energy installation process, both in location and layout, has, therefore, been addressed by specific sectoral planning, partial territorial plans, and urban planning through environmental impact assessments and landscape integration.

With the Energy and Climate Change Plan [44] (PECAC, 2012–2020), the Catalan government began to consider renewable energies as a strategic possibility for the present and future of the country, aware that wind energy had already reached such technological maturity that the decisive development of its potential was necessary.

PECAC’s main goals regarding wind energy are to:

- Formulate a new type of mapping for the implementation of onshore wind energy installations in Catalonia considering current and foreseeable technological development, and ensure its compatibility with the values of the landscape in which they are located.
- Promote the upgrading of wind farms that are more than 15 years old.
- Promote the development of micro- and mini-wind power in social communities; to allow small-scale energy production and areas that are directly related to a local economy, while facilitating the development of an industry associated with this type

of technology. To achieve decentralization, PECAC proposes supporting a net balance electricity supply, i.e., an energy balance compensation system that allows the user to self-produce part of their consumption, using the electrical system to release excess energy or capture it when necessary.

- Improve the quality of the distribution network supply and the overall efficiency of the system with the installation of small- and medium-power wind turbines in urban and industrial areas (industrial areas, shopping centers, farms, etc.) through the approval of specific regulations and guidelines.
- Create greater consensus between the various actors involved (promoters, local authorities, electricity companies, local communities, etc.) and, thus, recognizing that wind power is a renewable energy that is limited by a social response that is opposed to altering landscapes.

From an application point of view, the directives proposed by both the PECAC and the planning instruments limit themselves to promoting wind farms with a clear and legible image, defining basic recommendations for projects: a compact arrangement of wind turbines that reduces the area of interest as much as possible; the distribution of turbines according to a regular rhythm and in harmony with the prevailing characteristics of the landscape (topography, parceling, infrastructures, etc.); to avoid interventions in landscape areas of scenic interest or of symbolic value; and placing them as far as possible from inhabited centers.

However, these preventions and forecasting recommendations were too general to control and manage projects that were underway and planned, and, above all, they were not inherent to the issues related to landscape design, populations, and territory. So, to provide more suitable operational tools, in 2013, the Directorate General for Environmental Policies of the Government's Department of Territory and Sustainability (TES) commissioned the Landscape Observatory of Catalonia to draw up new guidelines. TES requested a report, addressed to technicians, professionals, promoters, communities, and local institutions, that would identify the best settings and conditions for the implementation of new wind farms, where the quality of the landscape was the priority target.

The relationship between landscape, energy, and climate change has been one of the pillars of the Observatory's roadmap, "Catpaisatge2020: Country, Landscape, Future" [45], and the investigation of the relationship between wind energy and landscape between balances, harmonies, arrangements, and perceptions offers a further and better chance to define a design attitude [46], which is key to fulfilling the objectives of the European Landscape Convention (ECL) to which the Parliament of Catalonia had already adhered in December 2000. The government published the report "Wind Energy and Landscape. Guidelines for appropriate installation in Catalonia" in 2020.

## 2.2. The Guidelines

This report consists of two parts: a first background in which we introduce the main challenges that today, in the midst of a genuine paradigm shift and starting with the economic, territorial, and social spheres, relaunch and address the relationship between renewable energy and the landscape. This is followed by a second applicative and propositional part with innovative methodological features in which criteria are established for the installation of wind farms that consider the characteristics, qualities, and diversity values of the landscapes, as well as their capacity to host them.

In the first part, the report elaborates on the state of the art, including the regulatory and planning framework in force in the country, the implementation methods, the territorial distribution of the installations, and the various wind farm projects under construction or approval, and offers a careful analysis of how wind energy relates to the landscape in the various territorial and urban planning tools.

As already mentioned, the report concerns the most relevant best practices at the European level registered in the new governance models based on decentralization and energy redistribution, on the knowledge and awareness of the population, and on an

improved involvement of local communities in terms of co-participation, in both the definition and location of wind projects and in the sharing of the consequent benefits.

The second part of the report presents the wind power infrastructure in terms of its landscape qualities. The infrastructure related to wind power is a strong aspect; the image of the artificial elements of the turbines is a highly technological, innovative, current image, and its contemporary identity can be read in contrast with that of the ancient territory that welcomes it. There is little attitude of appreciating its quality as a generator of sustainable energy.

The turbines appear to us as objects that are incongruous with their context: generally white and imposing in size, and because they are in motion, they are perceived as elements that constitute an exception within a consolidated landscape.

The turbines generate new perceptive situations, new relationships between the observer and the landscape that inevitably modify the original relationship of visual balance, but also of environmental condition, spatial dimension, and the whole; they merge with the landscape to modify it and generate a new arrangement, not least of identity and of place [47].

The type and size of the turbines determine the perceptive space and the resulting balance of visual tensions; their punctual, linear, or grouped positioning draws geometric compositions that, when well-designed and located, can emerge in the territory as extraordinary elements capable of becoming landscape elements in their own right.

The turbines enter into a visual relationship with the other landscape elements present: the natural elements, the topography, the characters and values present, the buildings, the vegetation, the materials, and the emergencies. They are read and perceived by our gaze in their whole and within a context, and, therefore, in their landscape dimension.

Our gaze selects, shifts weights, and measures, which implies that the logic and structure of the perceived landscape is a consequence of the logic of the structure of the turbines. The quality of the landscapes was evaluated both as a synthesis of the morphological, naturalistic, anthropic, and historical-cultural systems according to gestalt analysis, which studies the sensations that the landscape generates, and through semiological analysis, which searches for the characteristic signs of the territory.

The first part highlighted the configurations that characterize the features and specificity of landscapes in relation to the cultural elaboration of the perceived data. The second part described the quality and quantity of the data and information that could be acquired through a synthesis of the main values and characteristics of the landscape.

Specifically, in addition to the better-known perceptual gestalt theory, which is based on figure-background articulation, we referred to visual qualities such as perception and interpretation of image and sign. Ecological and functional relationships, history of transformations and society, beauty, contrasts, time, disharmonies, and the scientific conditions of phenomena provide new senses to meanings.

However, we also wanted to introduce a less explicit dimension of perception, that of the coherence of the landscape. The installation of turbines in the landscape results in a loss of coherence in the landscape and consequently decreases the scenic quality of the landscape. So, we opted for a correspondence between the perception of coherence and the preference for a scenic value.

With its load of signs, every landscape has a set of relationships that link humans to nature, the environment, and the society in which they live. This attitude of critical reading forms the culture and identity of the landscape designer, and, therefore, also informed this research.

Landscape is the realization of a polysemic relationship with the environment, as a stratification of denoted and connoted meanings, the result of natural, historical and economic expressions, the synthesis of a dialogue between culture and nature, between artifice and naturalness: perceptive acquisition and then codification of empathic sensitivity towards forms of expression [48].

Therefore, the more readable a wind farm in its unity and entirety, the more our gaze is able to select and isolate it as an autonomous system in relation to the landscape that hosts it. A simple, uniform geometric criterion for the arrangement of the elements is perceived as recognizable. A continuous rhythm, such as an arrangement according to lines or regular fields, allows easy identification of the design as opposed to a more dispersed and random geometry. A centralized and tight arrangement of the turbines is preferable to a sparse and dispersed one because the eye selects and limits the portion of landscape, giving the wind farm unit its own perceptive dimension in close relation to the landscape.

What is decisive is where and how the turbines are positioned and how and from where they are perceived; the relationship of scale, distribution, figure, background, rhythm, and repetition constructs optical syntheses and perspectives that are different each time. The multiple visual implications of depth, emergence, dissonance, contamination, contrast, and harmony concern the compositional modalities of the wind project and, therefore, are shaped by the arrangement of the turbines.

In the second part of the report, based on the general principles of the perception of wind turbines (shape, color, scale, arrangement, rhythm, and light signaling), the possible compositional criteria to be adopted are also identified (number, size, alignment, geometry, etc.), calibrated for the diversity of the Catalonia landscape.

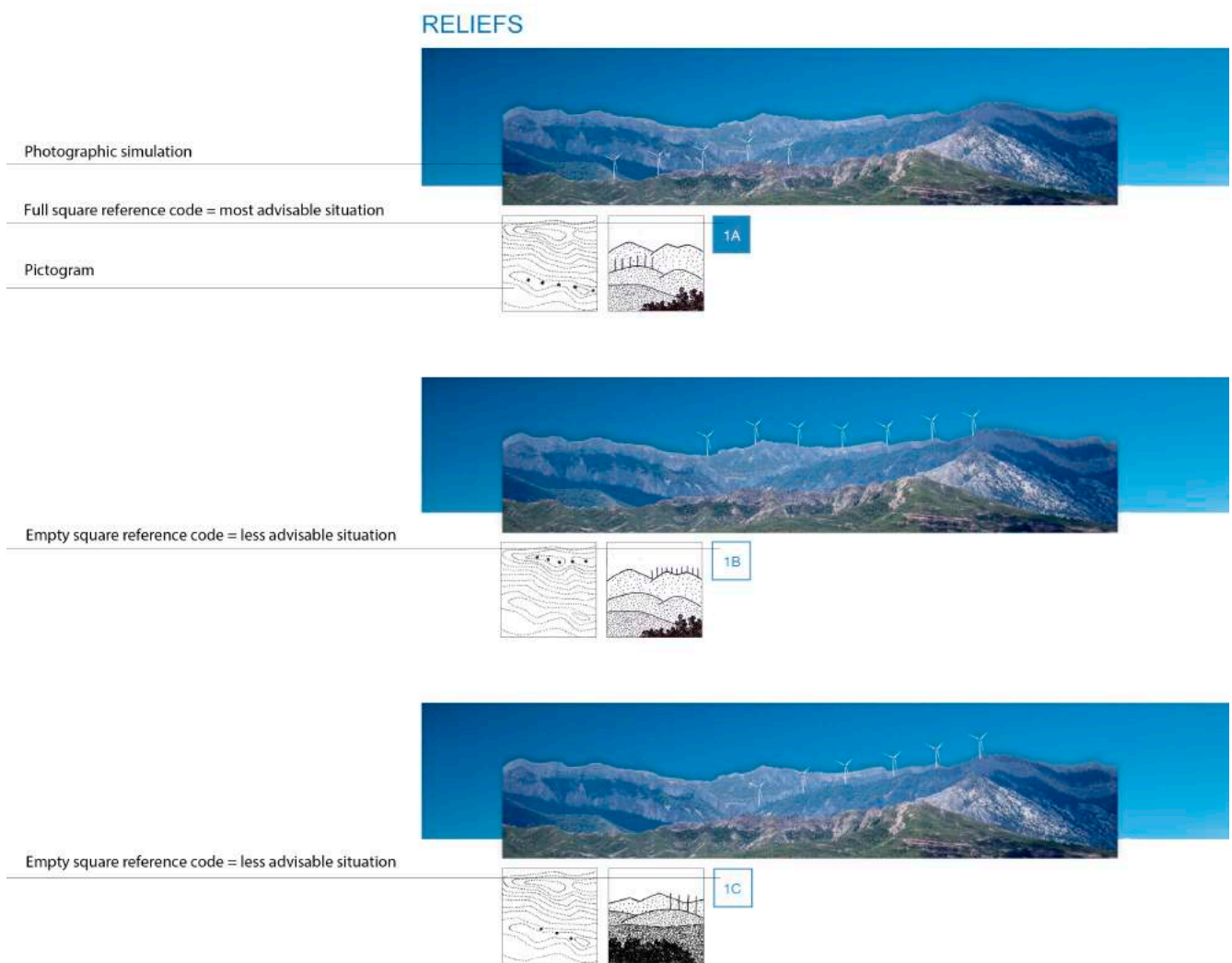
Taking advantage of the knowledge and experience gained by the Observatory in the writing of "The Landscape Catalogues" [49], the most representative features of the country's landscape heterogeneity were selected: reliefs and shapes, agricultural and forest landscapes, landscapes with historical buildings and heritage assets, etc. For each of them, different hypotheses were built for the design of wind landscapes. These hypotheses were visually and conceptually compared to evaluate implementation alternatives according to different degrees of compatibility.

All the possible configurations of the installation of systems respond to criteria formulated qualitatively downward, i.e., opting first for solutions that are highly advisable because they are qualitatively better from the point of view of the construction of the new landscape, and then opting for less opportune hypotheses when not discouraged.

The tool adopted to form the criteria, guidelines, and values explicit was a system of photographic simulations, accompanied by graphic representations and illustrative pictograms, named and numbered by reference codes. The color of the pictograms indicates the degree of compatibility in the area (Figures 1–3).

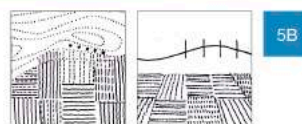
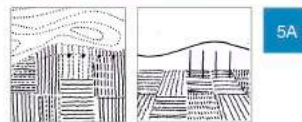
The sum of these criteria outlines an abacus of pictograms and reference codes, which is a tool for controlling and verifying the impact of turbines on the territory that is easy to consult and understand and is applied in the next phase (Figure 4).





**Figure 1.** Reliefs/shapes. Examples of criteria. The hypotheses are visually and conceptually compared to evaluate implementation alternatives according to different degrees of compatibility, from the most compatible to the least compatible. 1A. In the presence of successive reliefs, the location of the wind turbines in intermediate reliefs reinforces the perception of a greater depth of field and a greater understanding of the scenario. Conversely, prioritizing compact implements of linear composition avoids fragmentation and dissemination and ensures the readability of the whole. 1B. The location of wind turbines on the last ridge line of a succession of reliefs substantially modifies a potentially unique view and has high visibility from medium distances. 1C. When in a succession of reliefs, the wind turbines, located in an intermediate relief, exceed the ridge line of the last line of the visual field; the general perception scenario is one of confusion and imbalance. (All images and photo-simulations in this article were taken from the document “Wind Energy and Landscape. Guidelines for a suitable installation in Catalonia” and drawn up by the research group).

## CONTRAST OF RELIEFS



**Figure 2.** Contrast of reliefs. Examples of criteria. 5A. Faced with two well-differentiated forms and two landscape features, an agricultural plain and mountains, a set of wind turbines well-arranged on one of these forms allows the distinctive features of each to be perceived and clearly distinguished. 5B. It is important that the location and size of the wind turbines are consistent with the whole scene and do not compromise the reading of the differentiated characteristics of mountains and the agricultural plain. 5C. A disorderly arrangement of wind turbines between the mountain and the agricultural plain can reduce the clear distinction of the character of each landscape feature and interfere with the coherence of the whole. If, in addition, gaps are generated between groups of wind turbines, confusion can arise in the visual perspectives. (All images and photo-simulations in this article were taken from the document “Wind Energy and Landscape. Guidelines for a suitable installation in Catalonia”. They were drawn up by the research group).

## AGRICULTURAL STRUCTURES



**Figure 3.** Agricultural structures. Examples of criteria. 8A. In agricultural landscapes with well-defined traces (plots, paths, canals, fences, tree alignments, dry stone walls, etc.), a linear arrangement following these traces favors good insertion in the landscape and facilitates its reading. 8B. Geometric arrangements with clearly perceptible rhythms and layout patterns (within the same plot or set of regular plots), and with appropriate wind turbine heights, can generate good integration into the site. 8C. A wind development that does not follow the layout of the agricultural landscape expands the sense of disorder and distortion of the scene. (All images and photo-simulations in this article were taken from the document “Wind Energy and Landscape. Guidelines for a suitable installation in Catalonia”. They were drawn up by the research group).

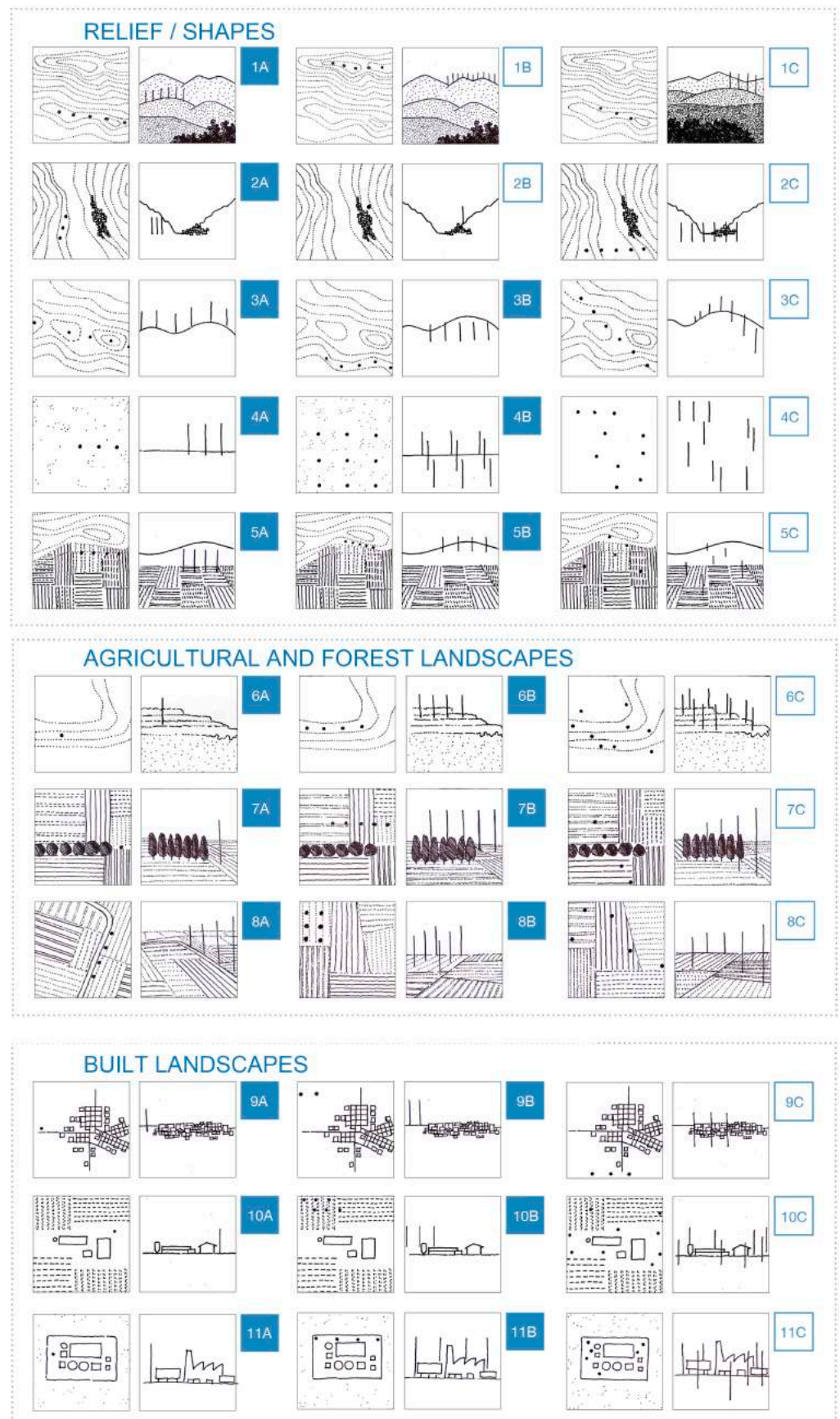


Figure 4. Part of the abacus of pictograms/criteria identified for each feature of the landscape.

In the last part of the report, some typical Catalan landscape scenarios are provided as case studies with which to test the criteria.

The panoramic scenarios characterizing distinct landscape units are identified: river terraces, agroforestry mosaics with undulating relief, flat agroforestry mosaics, agricultural plains, coastal mountains, rural settlements, undulating agroforestry mosaics with urbanization, and extensions of cereal cultivation. Small-scale everyday scenarios are also identified: industrial or logistic-commercial areas of little interest, chemical-energy production areas, peripheral residential areas or widespread rural peripheries, and areas enclosed by linear or port infrastructures.

The complexity of each scenario is highlighted using a single photograph captured from a height of 1.70 m from the ground, and from urban perimeter roads or places with a large number of people. This is accompanied by a description of the specific values and characteristics of the area, extracted from the “The Landscape Catalogues”, as a basic reference, together with further photographs that reveal the most prominent landscape elements in detail.

Finally, for each scenario, the most compatible wind energy installation models are identified according to different degrees and levels, using the criteria indicated and in coherence with the present landscape values (Figures 5–9).

The key factors for correctly interpreting the content of this application part of the report are:

1. Conceptual approach: The drawings and simulations presented here are conceptual approaches to possible reference models. Wind turbines will not actually be installed in these locations, but will have to comply with the specific guidelines and regulations of each individual location.
2. Three preferred viewpoints: The simulations, evaluations, and proposals assume three privileged viewpoints that correspond to the main points of simultaneous visual perception of the landscape of a certain number of observers: the perimeter areas of the villages, those of transit of infrastructures, and those of maximum influx such as viewpoints, tourist sites, areas of historical and heritage interest, etc.
3. Average visibility: The simulations, evaluations, and proposals are based on an average visibility of the wind turbines at between a 2 and 5 km radius. At this distance, while the generators remain dominant elements in the landscape, they do not impede the overall perception. It was, therefore, decided to eliminate both the close viewpoint (less than 2 km), for which the wind turbines occupy most of the field of vision, becoming absolute focal points, and the long-distance view, where the perception of the installations is less defined and has minimal visual impact.
4. Special attention to areas of symbolic value: As indicated in the landscape quality objectives of the “The Landscape Catalogues” composed by the Observatory, installations of new turbines will have to respect historical pre-existing artifacts of heritage value and areas of symbolic value for landscape areas of special importance.
5. A single wind turbine model: Even though the current market offers a wide range of wind turbine types and technologies, a single wind turbine model is always used in this report to provide a better graphic illustration of models, simulations, and positioning, and for a better and more direct transmission of the content.

#### RIVER TERRACES / HYPOTHESIS 1.1

The wind turbines are small or medium in height and are located on river terraces, without exceeding the slopes. They are distributed dispersedly, individually or in small groups, integrated into the traces drawn by the agricultural landscape (roads, trees, and plots), following the criteria regarding proximity to roads and urban centers. They can only be seen from short distances.

**Hypothesis 1.1** : *Wind turbines located on the ridge line of the bottom mountains.*



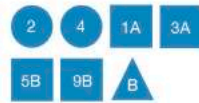
**Figure 5.** River terraces 1.1. Example of installation hypothesis in a representative scenario through the application of the identified criteria. Criteria adopted: 2: In general, wind turbines are arranged according to clear and regular geometric organizations (lines, curves, grids, etc.) and from the landscape patterns of the place to provide readability to the whole and reduce the feeling of clutter and visual confusion. 4: Spacing is regular between wind turbines and wind turbines of the same model, height, and color are used to emphasize the order and consistency of the set. 1B: The location of wind turbines on the last ridge line of a succession of reliefs substantially modifies a potentially unique characteristic and it has high visibility from medium distances. 3A: The linear arrangement of wind turbines in a wavy landscape following their morphological characteristics generates a clear and balanced image. 5B: It is important that the location and size of the wind turbines are consistent with the overall scenario and do not compromise the differentiated characters of the mountain and lowland agriculture. B: The implementation assumptions offer indicative heights for wind turbines from 50 m. (All images and photo-simulations in this article were taken from the document “Wind Energy and Landscape. Guidelines for a suitable installation in Catalonia”. They were drawn up by the research group).

#### RIVER TERRACES HYPOTHESIS 1.2

The wind turbines are located at a medium distance and do not exceed the saws, which promotes the perception of a greater depth of field, and act as visual shock absorbers. The linear distribution and regular spacing between the wind turbines make it easier to read the landscape, convey a sense of order, and lighten the perception.

**Hypothesis 1.2 :** *Wind turbines in linear composition on the first slopes.*

## RIVER TERRACES / HYPOTHESIS 1.2



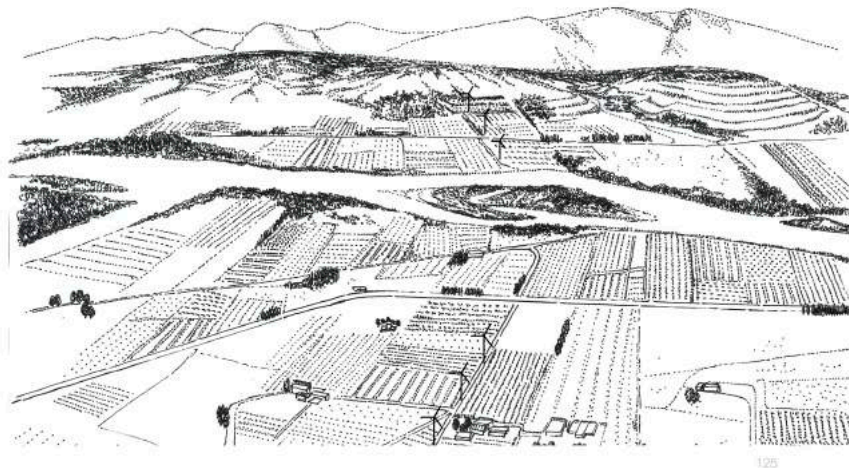
**Figure 6.** River terraces 1.2. Example of installation hypothesis in a representative scenario through the application of the identified criteria. Criteria adopted: 2: In general, wind turbines are arranged according to clear and regular geometric organizations (lines, curves, grids, etc.) and from the landscape patterns of the place to provide readability to the whole and reduce the feeling of clutter and visual confusion. 4: Spacing is regular between wind turbines and wind turbines of the same model, height, and color are used to emphasize the order and consistency of the set. 1A: In the presence of successive reliefs, the location of the wind turbines in intermediate saws reinforces the perception of a greater depth of field and a greater understanding of the scenario. However, prioritizing compact implements of linear composition avoids fragmentation and dissemination and ensures readability of the whole. 3A: The linear arrangement of wind turbines in a wavy landscape following their morphological characteristics generates a clear and balanced image. 5B: It is important that the location and size of the wind turbines are consistent with the overall scenario and do not compromise the differentiated characteristics of the mountain and lowland agriculture. 9B: Locating several wind turbines next to the town center or an urbanization, as long as it is measured and ordered and far enough away, can create new points of attraction, but without distorting the perception of the whole. B: The implementation hypotheses offer indicative heights for wind turbines starting from 50 m. (All images and photo-simulations in this article were obtained from the document “Wind Energy and Landscape. Guidelines for a suitable installation in Catalonia”. They were drawn up by the research group).

### RIVER TERRACES / HYPOTHESIS 1.3

The wind turbines are small or medium in height and are located on the river terraces, without exceeding the slopes. They are distributed dispersedly, individually or in small groups, integrated into the traces drawn by the agricultural landscape (roads, trees, and plots), following the criteria regarding proximity to roads and urban centers. They can only be seen from short distances.

**Hypothesis 1.3** : *Wind turbines located on the terraces.*

#### RIVER TERRACES / HYPOTHESIS 1.3



**Figure 7.** River terraces 1.2. Example of installation hypothesis in a representative scenario through the application of the identified criteria. Criteria adopted: 1: In general, for a set of wind turbines, a more positive image is obtained with a small number of large wind turbines instead of numerous small ones. 2: In general, wind turbines are arranged according to clear and regular geometric organizations (lines, curves, grids, etc.) and from the landscape patterns of the place to provide readability to the whole and reduce the feeling of clutter and visual confusion. 4: Spacing is regular between wind turbines and wind turbines of the same model, height, and color are used to emphasize the order and consistency of the set. 8A: In agricultural landscapes with well-defined traces (plots,



paths, canals, fences, tree alignments, dry stone walls, etc.), a linear arrangement following these traces favors good insertion in the landscape and facilitates its reading. 9B: Locating several wind turbines next to the town center or an urbanization, as long as it is measured and ordered and far enough away, can create new points of attraction, but without distorting the perception of the whole. 10B: Several wind turbines, aligned and located next to an agricultural complex, as long as they maintain a coherence with the place, can contribute new elements that reinforce the viability of the agricultural exploitation. A: The implementation hypotheses offer indicative heights for wind turbines up to 50 m. (All images and photo-simulations in this article were obtained from the document “Wind Energy and Landscape. Guidelines for a suitable installation in Catalonia”. They were drawn up by the research group).

### PORT INFRASTRUCTURES

Port spaces generate a heterogeneous type of landscape, which, due to the dimensions of its different elements, is a type of industrial landscape. The implementation of small- and medium-sized wind turbines in these port areas represents an opportunity to improve the perception of these areas.

These are spaces that, due to their characteristics, support almost any height of wind turbine, from the largest to the smallest. Wind turbines act as differentiating, unique elements, as they provide new values and elements of identity.

Port infrastructure is heavily used by both workers and passengers, and is an adequate space to generate wind energy for a significant number of people.

### PORT INFRASTRUCTURES



**Figure 8.** Port infrastructure. Example of an installation hypothesis in a representative scenario through the application of the identified criteria. Criteria adopted: 1: In general, for a set of wind turbines, a more positive image is produced with a small number of large wind turbines instead of

numerous small ones. 11A: A wind turbine located within an industrial complex does not significantly alter the landscape or its perception, and can even contribute to improving its quality, especially for regular users. 11B: Several well-organized wind turbines located within an industrial area contribute to providing new discourse and content to this landscape, complementing its industrial and technological image. The possibility of installing wind turbines in the plant areas or integrating them into the green areas of the same properties can also be considered. 12A: The linear arrangement of wind turbines adjacent to a road, especially a first-order one (road, motorway, or train), with regular distances between the towers, is consistent with the image of the infrastructure landscape; A: The implementation hypotheses offer indicative heights for wind turbines up to 50 m. B: The implementation hypotheses offer indicative heights for wind turbines starting from 50 m. (All images and photo-simulations in this article were obtained from the document “Wind Energy and Landscape. Guidelines for a suitable installation in Catalonia”. They were drawn up by the research group).

#### RURAL PERI-URBAN AREA

In many rural landscapes close to towns and cities, new uses and constructions, especially agricultural ones, have proliferated in recent years. These new settlements have not always been constructed in a way that respected the pre-existing landscape complexes, which has deteriorated some perceptions. A good method of regenerating these rural peri-urban spaces or even of creating new landscapes is to place small- or medium-sized wind turbines there. Wind turbines, as a modern element, allow the recovery of these landscapes or even reinforce images of rural urban areas, provided they are linked to actions of management and improvement in the landscape (demolition of obsolete buildings, improvement in degraded spaces, etc.). As such, production is also brought closer to consumption, surplus production can even be shared, and the links between territory and energy are strengthened through the proper landscape integration of wind turbines.

#### RURAL PERIURBAN



**Figure 9.** Rural peri-urban area. Example of an installation hypothesis in a representative Scheme. 1. In general, for a set of wind turbines, a more positive image is created with a small number of large

wind turbines instead of numerous small turbines. 2: In general, the arrangement of wind turbines according to clear and regular geometric organizations (lines, curves, grids, etc.) and from the landscape patterns of the place provides readability to the whole and reduces the feeling of clutter and visual confusion. 4: Regular spacing between wind turbines and the use of wind turbines of the same model, height, and color emphasize the order and consistency of the set. 7B: Placing a row of wind turbines parallel to tree screens or rows of trees, in a number that does not reduce their prominence, and with a recommended height of no more than three times that of the trees, creates a composition that is consistent with the structure of the existing agricultural landscape. 8A: In agricultural landscapes with well-defined traces (plots, paths, canals, fences, tree alignments, dry stone walls, etc.), a linear arrangement following these traces favors good insertion in the landscape and facilitates its reading. 9B: Locating several wind turbines next to the town center or an urbanization, as long as it is measured and ordered and far enough away, can create new points of attraction, but without distorting the perception of the whole. 10A: A wind turbine integrated within an agricultural complex can create a new landmark in the landscape and improve the perception of the agricultural complex. 19A: In a heterogeneous agricultural landscape, the coexistence of two different types of implementations, one collective and one individual, for example, should not disturb the perception of the whole, as long as they are well-located in relation to the landscape that hosts them. The correlation of the heights of wind turbines is maintained. A: The implementation hypotheses offer indicative heights for wind turbines up to 50 m. (All images and photo-simulations in this article were obtained from the document “Wind Energy and Landscape. Guidelines for a suitable installation in Catalonia”. They were drawn up by the research group).

### 3. Results

#### 3.1. *From the Nature of the Wind to the Culture of the Landscape*

In this application part of the research, we identified solutions compatible with the qualitative values of the selected scenarios, and explored the unexpressed potential of wind energy in the configuration and redefinition of landscapes where it is currently difficult to identify characteristics of coherence, legibility, and/or identity. The development of wind energy is considered in this sense, and for this research, to be an important strategy for adding value to the territory, in adherence with the complex processes of change.

In addition, the research provided an opportunity to investigate a vision of renewable energy in its new forms of relationship with the landscape and its future arrangements.

The construction of wind energy infrastructure ultimately implies the construction of a complex perceptual strategy that is a function of the landscape characteristics of each place and its relationship with the population. It is, therefore, a question of generating a dialogue between wind energy and the landscape in which physical issues such as scale, the number of elements, their distribution, and the consequent infrastructure, as well as perceptive ones, play a role, creating symbolic values, identity, and belonging in places.

The landscape is a cultural product that is the result of human activity and the numerous manifestations of its existence. The landscape is a field of signification; it is the writing on a territory of the human condition. It is a cultural product because it is composed of places, differences and heterogeneity, and spaces where other and new meanings overlap and transit. It is a cultural product because of, and how, it is perceived.

The landscape is the relationship between humans and the environment, and between nature, culture, society, and individuals. It is the relationship between distinct fields of thought and knowledge related to space; it is a place of conflict and compromise, of dialogue and interpretation through distinct syntaxes.

A landscape approach emphasizes the relationship between elements rather than the objects. A project is a system of language that is positioned in a place with its stories, feelings, and meanings, which are hybridized within it.

An action, plus a road, plus a house, plus a tree, can be the basis of a project, provided that it establishes a sequence of communicable sense in the landscape and as a landscape.

The landscape is, therefore, a system in the sense of the sum and superimposition of numerous levels of information in relation to each other, and in the sense of time, space, scale, and dimension. It is a system because it is a unit of multiple data and factors.

Human activity introduces new and overlapping levels of information and transformation as autonomous and independent layers: avant-garde technological installations, sustainable energy networks, alternative energy production platforms, plants for the exploitation of clean resources, etc.

System is an acquisition of meaning-stable, like extemporary, ephemeral or on loan-transmittable to one or more sequences of elements and dimensions, communicable as values, entities that are “isolated” in a continuum of events that characterize a place, as factors of identity and predisposition of a vocation to evolve, otherwise no longer expressible [50].

The complexity of the landscape becomes the narrative structure that makes explicit the modifications and values of a contemporaneity in succession, legitimizing them as a new signification of landscape [51–53].

Landscape, as the scenic space of the flow of experience, is inseparable from the narration of experience. It is, therefore, an open text. “The landscape is the face of the land and as such is one of the best indicators to quickly understand its good or bad health. We do this not only through sight but through all our senses. And it is not only a cognitive act but also an emotional one” [54].

The wind power infrastructure is one more system—an information layer with which the new landscapes are equipped.

The sequence of turbines, in their arrangement and type, defines a whole that is unique in its implications for scale and dimension. Wind turbines, adapted and in tune with the morphology of the land, become a system unit, because only as such does the installation provide meaning as well as function. This implements the image and future projection of sustainable landscapes [55].

The installation of a wind farm should express the characteristics of an energy transition strongly linked to the actuality of our time, that is, linked to each place, de-centralized, and redistributed, with the participation of local communities, both in the definition and location of wind projects and in the sharing of the consequent benefits. Energy projects support their resulting innovation of forms and spaces, in ecological arrangements of new energy landscapes [56,57]. This generates a new relationship between the wind farm and the landscape, which creates both physical issues (scale, distribution, depth, perception, etc.) and conceptual issues (ideological and identity values) in the dialogue and its content.

Ultimately, the wind power infrastructure, by embracing technological innovation, expands the culture of energy production that is bound to the landscape. Notably, while it is true that from an energy point of view wind power brings energy production closer to the places where it is consumed, this study shifts the focus of its objective from the design of performance landscapes to the design of cultural landscapes; in this sense, our aim is to define wind landscapes as a new nature. Consequently, it broadens the culture of landscape, because it adheres to an emerging, contemporary, and current idea of landscape [58,59]. Thus, wind power becomes a landscape element.

A wind park is, therefore, a cultural product because it is the expression of a complex and contemporary condition of landscape, of its level of transmission, and information of energetic, perceptive, social, economic values, never static and progressively better in the ethical and esthetic quality of its design. It is the landscape that legitimizes its new status as an energy project.

Starting with the landscape and using the logic of the landscape, we intercept the qualitative terms of the dialogue and relationships woven by the two infrastructures. The performance characteristics of innovative technologies are combined with social, anthropological, and environmental characteristics, creating the shape of ecology: nature of the wind, culture of the landscape.

### 3.2. Conclusions

The conclusions focus on the two basic aspects that envisage the application of this study in the future: conceptual-ideological and political-implementation aspects.

The conceptual-ideological aspect is, as explained, about landscape design.

Wind energy becomes an element of technological innovation that (re)creates a culture of energy production, linked to the landscape to the point of becoming a landscape project in itself. The landscape, thus, welcomes the innovation of an energy project that is not measured on a geographical scale, but that draws from geography the overwriting of everyday places to which it provides meaning and orientation, significance and narrative.

The political-implementation consequences are linked to new energy strategies of public governments.

The scientific result of this investigation, in the outcomes that followed, generated important reactions from the clients and the administrative departments involved.

At present, the implementation of wind energy is governed by Decree No. 16/2019 on Urgent measures for the climate emergency and the boosting of renewables, which simplifies the authorization process for new wind and photovoltaic installations and has created the opportunity for dozens of wind parks and hundreds of new turbines in a short time, again in specific areas, and without mechanisms for participation of local agents and communities. Even if the report has been waylaid for a long time, with this decree, it is adopted as an implementation tool: the Urgent measures for the climate emergency and the boosting of renewables of the Generalitat increases the prominence of the landscape in directing a location assessment for new renewables. It is a step that does not allow the solution of the current processes to emerge, but encourages greater and better action of adhesion of the energy transition to the environmental systems, toward a more conscious idea of equilibrium, to which this work has given impulse and reason.

The originality of this study lies in that it shifted the conceptual weight of energy sustainability from performance parameters to qualitative landscape values by overturning the approach of the work: this was not a project for the correct installation of wind power plants, but a project for a wind power plant capable of enhancing the territory, in a new and unified landscape configuration, as long as the principles of subsidiarity, democracy, and territorial equity of the European Landscape Convention and Agenda 2030 are followed.

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