

The Energy Transition as a Design Task: Wind Energy Planning and Design Strategies and Principles Based on the European Landscape Convention

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ABSTRACT

Planning policies often seek to concentrate the “impact” of renewable energy in supposedly “worthless” landscapes by differentiating them according to their scenic “value”—rather than contributing to the new beauty of all types of landscapes by integrating the new elements into different types. The selection of wind turbine sites guided by these planning policies and the subsequent landscape changes have exacerbated public concerns and negative opinions of renewable energy development, which hinders the progress of the energy transition. According to the European Landscape Convention (ELC), all landscapes are valuable, subject to change, and require good design. This article suggests, from the perspective of landscape architecture, that renewable energies represent new scales in the landscape, but can also be perceived as closely connected to nature. The ELC-based design strategies for landscapes with wind turbines in European regions have been discussed, demonstrating that new, shared, professional conventions have emerged to connect the new dimensions and natures of renewable energy with existing landscape morphologies and infrastructure. Adhering to the new principles of the wind energy landscape design, landscape architects can collaborate with citizens involved in the planning process to translate their input into design language and diverse concepts. This positive planning and design approach exhibits the potential to contribute to the mitigation of social conflicts through the integration of energy infrastructure into everyday spaces and cultural landscapes.

KEYWORDS

European Landscape Convention; Wind Turbine; Design Strategy; Renewable Energy; Energy Landscape

HIGHLIGHTS

- Critically interprets the strengths and challenges of wind energy landscape planning and design in Europe
- Based on the ELC, a positive conceptual and planning approach is developed for the energy landscape
- Design thinking facilitates the integration of energy infrastructure into everyday spaces and cultural landscapes

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1 The Relationship Between Energy and Landscape

In Europe, like in all continents, the transition towards renewable energies means a return of energy production to the entire region. “Return” here indicates that until a few decades ago, landscapes were characterized by energy production through the decentralized use of water and wind power, as well as wood and grain production for horses. It was only through coal mining and the import of oil and gas from outside Europe that utilized landscapes “totally”^[1] for this purpose, often to the point of complete destruction, as in the case of opencast lignite mining.

The return has signified a further transformation in cultural landscapes, though by no means its destruction, but rather an opportunity. In contemporary discourse, European cultural landscapes exhibit a structural richness in the historical period circa 1850. This is widely considered to represent an ecological and aesthetic “optimum” with respect to biodiversity and scenic beauty^[2]. However, the wealth generated during that time did not extend to social prosperity, but was rather associated with harsh living conditions and severe conditions of exploitation for the vast majority of the population. In Europe, not yet worldwide, on the one hand, much of this poverty; but, on the other hand, much of the structural richness of the landscape has been eliminated primarily by the industrialization of agriculture, as well as by the “total”^[1] spatial conquest by mobility infrastructure. The opportunity now lies in shaping the changes so that structural richness and beauty are once again promoted as positive effects of the land use system, to remedy the alienation between humans and nature.

However, this return does not mean restoring historical images: new energy production must take place in other dimensions due to the much higher energy consumption of our time. For example, wind turbines, with their small foundations, hardly interfere with biological or geological structures; but the completely new sizes of the plants, currently up to 300 m respectively, change the familiar appearance of the landscape. Solar plants interfere even less with the basic structures of the landscape but take up many times more space and are, therefore, also a new phenomenon in the landscape.

Renewable energies representing new dimensions are also more closely linked to the landscape than fossil fuels due to their land requirements, decentralization, and volatility. But there are differences here: while with wind turbines, one can directly experience the transformation of the natural power of wind into energy in the landscape, this is hardly the case with solar installations. The energy transition, therefore, means very different intensities of utilization of the landscape and its structural, visual,

and associative changes^{[3][4]}.

But what is landscape in this context? It is a perceived, meaningful context of space with specific structure and character that is shaped by natural forces and—in cultural landscapes—always by human activities. “Natural” substance and character, as well as the associative context that must exist for space to be perceived as landscape, represent values and goods that are in the public interest. As a free, collective, or merit good, “landscape” with its grown and cultivated substance, character, and context should be protected and newly created.

These social and cultural aspects of the landscape could be taken particularly well into account in the planning and design of renewable energies. Because, unlike fossil fuel producers, their decentralized and volatile nature gives them a “genetic landscapability” and thus the potential to overlap with other ecological and social functions. For example, community and co-operative plants can strengthen social ties and identification. As niches and edges in the landscape^[5], residual areas under wind turbines and solar installations can offer social retreats and places of development and encounter, as well as new ways of experiencing the forces of nature.

The prerequisite is that the facilities are a recognizable part of the multifunctional landscape. Therefore, it is important not to plan them as “self-referential” industrial plants, but to design them as new cultural landscape elements. There are official concepts for this in certain European countries. Germany, however, where the author works, is, although a leader in transition, underdeveloped in landscape planning and design strategies. There are indeed an increasing number of institutions calling for the design of landscape changes, such as the Federal Foundation for Building Culture, the Federal Chamber of German Architects, and academies for urban development, spatial research, and rural areas. However, there is no planning and design instrument in the official German procedure.

2 Different Views of the Renewable Energy Landscape

In other countries, especially in Western Europe, from south to north, this is indeed different. These countries share a fundamentally different understanding of landscape culture, which they proclaimed in 2000 at the European Landscape Convention (ELC). This calls for “acknowledging that the landscape is an important part of the quality of life for people everywhere: in urban areas and in the countryside, in degraded areas as well as in areas of high quality, in areas recognised as being of outstanding beauty as well as everyday areas [...] that developments [...] in many cases

accelerating the transformation of landscapes [...]. Believing that the landscape is a key element of individual and social well-being and that its protection, management, and planning entail rights and responsibilities for everyone [...]" leads to the definition that "landscape planning' means strong forward-looking actions to enhance, restore or create landscapes"^[6].

Therefore, European countries that have joined ELC have officially defined the integrating renewable energies into the landscape as a design task. Outstanding examples of such approaches have been developed in Denmark, Scotland, the Netherlands, France, Belgium, and Spain. Usually, as will be demonstrated, they were created by landscape architects and architects and are based on recognized rules of perceptual psychology, aesthetic spatial perception, and classical theories of proportion. Their results have been incorporated into practice through official guidelines issued by ministries. There, renewable energies are actually integrated into the landscape "in such a way that they create meaning by being conspicuous (easily perceptible and understandable), meaningful (associated with meaning) and sensible (as an intelligent change) and as such convey themselves aesthetically"^[7].

3 Landscape Planning and Landscape Architecture With Wind Turbines

The Netherlands occupies a special position in the European cultural landscape because large parts of its land were wrested from the sea. They are completely "artificial" landscapes and can only survive if they are constantly defended against the forces of nature. For centuries, this landscape has included thousands of windmills, which had to be used to pump the water out of the land. This has been called a "second nature," one made by humans, with an impressive, specific beauty. It was also discussed early on what a rise in sea levels due to climate change would mean for this national defence. Accordingly, the Netherlands was quick to address the modern form of renewable wind energy in an aesthetically open manner^{[8][9]}.

As early as 1986, the Bureau B+B based in Amsterdam carried out a study on the design of 260 wind turbines in the IJsselmeer^[10]. The project documentation states: "Wind-mills. Proud and stately. Not just suppliers of energy, but also superb examples of technical progress. Striking beacons on Dutch landscapes, vertical accents in a country with unlimited horizontals"^[10]. Arranging the turbines in one row, so the planners, would be "too much of a good thing"; instead, a compact triangle directly on the coast on both sides of

the Lelystad road dyke would appear as artificial as the dyked IJsselmeer itself, symbolizing the future.

Today, so-called "image quality plans wind energy" are drawn up in the Netherlands for larger wind farm projects. A new plan was also developed in 2017 for the Lelystad region^[11]. This plan takes on a new dimension, as it is no longer just a question of harmoniously organizing wind turbines in the landscape, which is done by geometrically "tidying up" corners, stand-alone turbines, gaps, etc. Instead, a design deliberately dubbed "wind turbine landscape" is intended to help enrich the landscape. For example, an almost completely geometrically rectangular agricultural landscape is to be given a further level of perception through long, curved lines of wind turbines. In another section of the landscape, wind turbines are to follow the existing structure of the wide grid of roads and settlements in a "regular irregularity." Finally, avenue trees planting as proportionally mediating structures can take away the turbines' domineering character. This example does not mean that wind turbines only fit into artificial landscapes; on the contrary, other studies and practices from, e.g., southwestern Europe, demonstrate that an appropriate design can also fit into what one calls "natural landscapes."

4 Mitigation of Social Conflicts

In 1994, the municipality of Løgstør, on the Danish peninsula, developed a plan to relocate the "unfortunately sited" turbines along the coastline, "to produce a more harmonious landscape than is the case today"^[12]. Holiday and camping sites, beaches, flat meadows, few forests, small towns, and many solitary farms characterized the coastal land. The planning project cooperated with interest groups and stakeholders, such as land and turbine owners, groups of nature conservation, tourism, forestry, and energy, and architects from Møller & Grønberg (Fig. 1).

At that time, there were 132 turbines under 50 m erected. Even if these scales seem small compared to today's plants, the architects had already formulated rules that remain applicable today: "So the main problem is not the individual turbine, but the aesthetically unfortunate interplay between the turbines and the long-distance impact of the turbines which increase in proportion to the size of the turbines [...] with different constructions and varying group sizes [...] and their apparently random locations [...]"^[12]. In order to not only preserve and highlight the various landscape characters, the plan divided the region into varied types of landscapes: flat, heavily rolling, hilly, and moderately rolling. More than constructional aspects the plan differentiated harmonious



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1. Wind turbines in the Öresund off Copenhagen, Denmark. The arrangement of the wind turbines was originally designed in a referendum. Energy landscapes are not static and permanent, but rather dynamic and constantly changing. This constitutes a fundamental insight into the approach to design tasks and the development of concepts.
2. Distance examples of 2H, 3H, 4H, and 10H Hamberg wind turbine that is 179 m in total height.

formations, such as scattered individuals, hill profiles following rows, and triangular patterns^[12].

The plan stated, “different landscape types require different ways of erecting wind turbines [...] specifically assessed in each and every case”^[12]. As a result, the plan showed four scenarios, following different siting rules, calculating the resulting energy production, and describing the landscape impact through text, aerial images, figure-ground-plans at the regional scale, and panoramic visualizations from different viewpoints. Although the coastal region and the very small heights (Fig. 2)—display a special case, this project stands as an early model for following analysis and planning strategies all over Europe.

The aim is not to reduce, limit, or hide, but to integrate, respect, and merge formations, by designing connective shapes. A similarly differentiated position on the question of what effects the design of such formations can have on compatibility or even quality improvement was already stated in Swedish studies in 2007: “A large wind farm can never be hidden, especially in an open mountain landscape. But a group of wind turbines can also help to make it easier to find your way around an otherwise relatively

monotonous landscape. The location of the wind turbines on the mountain top can also enhance the experience of the height at which they are placed”^[13].

Moreover, in the Atlantic climate of northern Europe, the first systematic empirical research was carried out on the design and social acceptance of landscape changes caused by wind turbines. In 1994, Caroline Stanton published the results of her investigations into the design and, in particular, the proportions of wind turbines in the landscape, as part of which she had also conducted surveys^{[14][15]}. In 2009, Stanton wrote the Scottish Natural Heritage publication *Siting and Designing Windfarms in the Landscape—Version 1*^[16]. As far as the author is aware, it is the first comprehensive design work on wind farms in the landscape. A compact analysis of landform, scale (in relation to the skyline), perspective, land use, landscape and visual patterns, focal features, and settlement structure leads to clear general and specific rules “for most rural areas of Scotland.” The Scottish guidelines are characterized by an unbiased and differentiated view. For example, when it comes to the increasing size of wind turbine generations: “large wind turbines may appear out of scale and visually dominant



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in lowland, settled, or smaller-scale landscapes, often characterised by the relatively 'human scale' of buildings and features. On the other hand the longer blades of larger turbines often have slower rotation speeds and this can be less visually distracting [...]”^[16].

5 Learning From the ELC

Despite systematic planning and design principles, which have been in place since 2009, many analyses in the UK apparently remain caught in the extensive Landscape Character Analysis (LCA)^{[17][18]}. Their aim is generally to minimize the “impact” through sensitivity and capacity analyses of different landscapes by ensuring that landscapes assessed as particularly sensitive receive no or only a few wind turbines, and that these are always grouped together. In this way, the LCA denies that the turbines can be integrated into the landscape, but see them as an alien phenomenon. This hardly opens up any scope for design and a positive image in which the new elements can be brought into a new context of the existing landscape.

The second extensive, creative examination of wind turbines appeared shortly afterwards in France^[19]. In line with the landscape culture there, the structures of land use, historical visual axes, and cultural monuments play a particularly important role. However, even here, it is not assumed that landscapes can remain static. Therefore, “it should be less about preserving and protecting the landscape”^[19] (in the classic sense of the term) from wind turbines, and more about aiming for successful landscape design. Because of the size of the turbines, any attempt to “conceal” the wind farms in the landscape is doomed to failure. It is therefore important to take “far-reaching, forward-looking measures to improve, restore or create new landscapes”^[19], as required by the ELC.

In addition to understanding the morphological characteristics of the site terrain, it is also important to record and assess the sensitivity of the cultural heritage and the landscape to wind turbines, which is examined using several approaches parallel and treated equally:

- 1) Visual analysis of the landscape context in terms of perceived scale, significant views, landmark elements, and visual fields;
- 2) The approach to the collective perception of the landscape by people and/or social groups (not by individual interests);
- 3) The recording of the development trends of a landscape in terms of its stability, traditions, changes, and neglects—and whether a wind farm will give both respect and a new dynamic to the landscape, and to the meaning of places^[19].

6 Challenges for Landscape Planners and Architects

Will assessment methods lead to a more careful or more difficult selection of suitable locations for wind farms in the future? In Europe, the limitation of suitable sites has been primarily a question of acceptance by the population, which is anticipated by local or regional planning authorities and political bodies. Overcoming this “Not In My Backyard”^{[20][21]} problem requires more regional than national concepts. A handout considered here was published in 2020 for the Spanish region of Catalonia. Here too, the authors of the handout are of the opinion that the method can also lead to wind turbines being sited very cautiously in certain landscapes^[22], but in certain cases go beyond the principle of designing the most careful and respectful integration: “the potential of these wind turbines to provide more quality of life and identity to commercial, logistic and industrial areas of low interest, chemical energy parks, peri-urban residential areas or disordered rural suburban spaces and spaces situated between linear infrastructure or port infrastructure, which are places where it is difficult to recognise landscape consistency or values. Based on the criteria [...] wind turbines may bring aesthetic or identity-based values or even become new factors of economic attraction”^[23].

Germany is also facing the challenge of finding suitable locations for wind farms, especially in the southern regions. In recent years, German society has changed its perception of the impact of renewable energy sources on the landscape. What opportunities do these changes offer for landscape planners and architects? Regional concepts are also needed here, but they must also be understood as fair and balanced throughout Germany^[24]. Otherwise, not only will the fundamentally strong acceptance of the energy transition suffer, but existing conflicts because of structural and economic differences between urban and rural areas, east and west, north and south of Germany will be exacerbated. In light of several decades of deliberate disparagement of renewable energies and non-design-oriented specialist planning, there is an imperative for the resuscitation of positive conceptual thinking in a participative bottom-up process.

The author’s team is currently conducting two research projects funded by the German Ministry of Economic Affairs and Climate Change. We are working with citizen participation in a new method in which citizens are actively involved in developing concepts (Fig. 3). Normally, citizens can only raise “objections” if they are “affected” by expert planning. For these design concepts to be seen as objective, landscape-related, and fair, the site proposals for wind turbines and solar installations must be based on overarching,



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3. Presentation of the results of a participation workshop on actively shaping the energy transition by workshop participants in the Citizens' Hall of Zittau, Germany, on March 17, 2025.

landscape-related rules. Translating local proposals into general rules is the core of our contribution to this process. In other words, our team does not design the energy landscape, but instead provides the design language. In our experience so far, this can really only be done by landscape architects, but rule-governed conceptualization is often a real icebreaker for the citizen groups, as well as for the wider public in an otherwise deadlocked debate about appropriate and fair distribution of renewable energy plants.

7 Landscape as a Mediating Level Between Everyday Life and Infrastructure

What could landscape be in relation to renewable energy?

In the spirit of the ELC, there is a mandate to enable renewable energies in all landscapes, to preserve the features and differences, to contribute to improving the situation in damaged areas, to keep the landscape open, to develop it further, to redesign it, and to understand this as a collective, local task of building and landscape culture.

Despite all aesthetic concepts, it should also be stated that there are of course “no-go areas” (taboo areas) for the siting of wind turbines. These are all areas where populations of avifauna—beyond individual specimens—could be harmed by the wind turbines. These are distances that must be maintained from residential areas to ensure that emissions from wind turbines—especially shadow flicker and noise—do not cause a nuisance to people. Beyond these absolute ecological criteria, there is a wide scope for aesthetic and social concepts.

The following aspects, therefore, play a role in all guidelines of the countries mentioned above, which are based on the principles

by the ELC:

- 1) Differentiated and complex assessment of landscape and social sensitivities.
- 2) Recording the landscape in visual sections that correspond to people's natural visual abilities and structuring spatial perceptions.
- 3) Consideration of important visual axes between significant locations in the natural and cultural landscape.
- 4) Integration of wind turbines into the existing morphology of the landscape.
- 5) Integration into the proportional relationships to other structures in the landscape.
- 6) Arrangement of wind turbines as legible forms in the landscape.

Landscape is then no longer an obstacle to the energy transition, but a principle for creating qualities and contexts with which it can succeed aesthetically. The landscape thus functions as a mediating level between the everyday lives of individuals and the major infrastructural frameworks that are indispensable to their activities. The interests of renewable energies and landscape should not be weighed against each other, but combined as a new cultural concept.

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能源转型作为设计任务： 基于《欧洲景观公约》的风能景观规划与设计的策略和原则

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摘要

目前的规划政策通常未能将新的能源景观元素融入不同的景观类型，以提升各类景观的美学质量，反而是根据不同区域的景观“价值”，试图将可再生能源的“影响”集中在所谓的“无价值”区域内。遵循这种规划政策的风力涡轮机选址和相应的景观变化，加剧了公众对可再生能源发展的担忧和负面看法，阻碍了能源转型进程。根据《欧洲景观公约》，所有景观均是有价值、处在变化之中的，也都需要良好的设计。本文基于景观设计学视角，指出可再生能源设施尽管在景观中呈现出前所未有的空间体量，但仍与自然密不可分。本文通过探讨欧洲地区基于《欧洲景观公约》的风能景观设计策略，提出景观专业领域已逐渐达成新的共识，旨在将可再生能源景观特征及空间体量与现有的景观形态和基础设施相结合。遵循新的风能景观设计原则，景观设计师可以与参与规划的市民代表协作，将公众意见转化为设计语言和多样化的设计方案。这种积极的规划设计方法有助于将能源基础设施融入日常空间和文化景观，从而缓解相关社会冲突。

关键词

欧洲景观公约；风力涡轮机；设计策略；可再生能源；能源景观

文章亮点

- 批判性地解读了欧洲风能景观规划与设计的优势与挑战
- 基于《欧洲景观公约》，为能源景观开发了一种积极的设计理念和规划方法
- 设计思维有助于将能源基础设施融入日常空间和文化景观

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