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Wonderland of technology? How energy landscapes reveal inequalities and injustices of the German Energiewende

Stephan Bosch, Matthias Schmidt

The aim of this study is to gain a better understanding of what characterizes energy landscapes in general and to what extent they are an expression of social inequalities and injustices in the specific case of the German Energiewende. In the sense of a review, the central findings will be integrated into the spatial concept 'production of space' by Henri Lefebvre. This is intended to uncover those social spaces that are produced by the powerful actors of the Energiewende and that become unequal and unjust energy landscapes on the basis of neoliberal spatial concepts. In addition, it is necessary to discuss a conceptual question that has hardly been considered so far: whether and how can energy landscapes be distinguished from other landscapes and where exactly should the lines of demarcation be drawn in the context of debates on energy justice? It is shown that spatial demarcation based on the representative, symbolic, discursive, and thus material-abstract phenomena of landscape is an appropriate way to understand the population's resistance to the dominant territorial-institutional structures of the Energiewende. The study concludes that the achievement of climate goals appears realistic if the production of sustainable energy landscapes is primarily understood as the production of a discourse about sustainability, equity, and justice.

Keywords: Energy transition Renewable energies Energy landscapes Energy justice Production of space

1. Introduction

The German energy transition (Energiewende) is accompanied by serious changes in the technological, economic, and political systems' structure. The introduction of the Renewable Energy Sources Act in 2000 was a pioneering step in this process, which obliged grid operators to purchase renewable electricity and guaranteed operators of renewable energy plants feed-in tariffs above the market price for a period of twenty years [1,2]. This made Germany the pioneer country of the energy transition [3] and aroused great admiration abroad. US experts were amazed at the ambitious energy policy which, despite negative effects on Germany's global competitiveness and despite heavy financial burdens on private consumers and companies, was able to persist stably across various governing coalitions ([4], p. 5). Yet this positive external perception is countered by great scepticism at home. Political debates voice the concern that the parallel phase-out of nuclear and coal-fired power might overstretch the national economy and society [5], as fewer and fewer people are prepared to bear the high public expenditure on renewable energies [6]. Criticism is also directed at the excessive speed with which Germany wants to drive the transformation process forward [7]. According to the authors, this does not allow industrial companies to make long-term plans, thus reducing their willingness to invest and confronting households with additional costs. Moreover, it is unclear how the energy transition will affect labour market developments [8] and how electricity grids can be stabilised in view of a rising share of intermittent energy sources [9]. Consequently, the aspects of 'electricity prices', 'competitiveness', 'time management', 'labour market development', and 'security of supply' are at the forefront of social debates. Fischer et al. ([10], p. 1580) speak of the "five controversies of the Energiewende".

Although economics and technology are important levers for the energy transition, Sovacool et al. [11] criticize that the debates on energy policy and energy technologies are reduced to economics and technology alone. In Germany, described by Blackbourn ([12], p. 179) as a "Wonderland of Technology", this is particularly the case, as the country's economic success and its economic policy's self-image since the beginning of industrialisation have been strongly linked to its own numerous achievements in natural

sciences and engineering. It is therefore not surprising that the energy transition is also taking place in the logic of a technology-driven "conquest of nature" [12]. Since the early days of industrialisation, the means of breaking down of societal and economic barriers has been sought in technological progress. However, this technocratic approach ignores the fact that the sociotechnological effects of the Industrial Revolution are not comparable with those of the transformation currently underway. The former was based on a strong mechanical, entrepreneurial, and spatial centralisation [13], whereas the latter is predominantly 'locally' oriented ([14], p. 1258), thus penetrating the everyday spaces of the rural population to a much greater extent, especially with regard to technological installations ([15], p. 583). In many places, this leads to a tense relationship between people and technology. The tensions are not only about the struggle of people against the material foundations of the capitalist mode of production ([16], p. 24ff.), but also about new social questions that challenge the benefits of the energy transition.

Possibly the current "disorientation in the Energiewende" [17], which manifests itself in an energy-political wobble, in massive drops in annual expansion figures, and in job cuts in the renewable energy sector ([18], p. 34), is already the consequence of a one-sided debate that reduces technologies to neutral and passive means of production. The narratives produced by politics, such as 'sustainability', 'climate neutrality', 'resource conservation', and 'competitiveness', may well be expedient and rational drivers for the expansion of renewable energies in view of the global ecological crisis and can make a powerful contribution to social disciplining via top-down mechanisms ([19], p. 7). Still, empirical findings on the acceptance of the energy transition reveal a great deal of public scepticism [20] towards political strategies and spatial concepts of the Energiewende. In order to understand the relationships between renewable energies' locations and their respective residents, research must focus on the places where people and technology meet. These places are referred to in the literature as energy landscapes [21,22,23].

In the tradition of socio-technical and critical-materialistic approaches, we assume that the emergence of renewable energy landscapes is the result of a social change, which leads to a technological change. We suppose that the acceptance of energy landscapes is not primarily linked to technological properties, but rather to local discourses, contexts, and power relations in the technologies' surroundings. We therefore presume that renewable energies do not generate social conflicts by themselves, but stimulate long-standing conflicts in the respective local conditions. In this sense, we do not regard renewable energy locations as "neutral empty spaces" ([24], p. 6747); rather, we see them as pre-formatted carriers of social structures and processes. Despite all criticism of technocracy, an analysis of the prevailing technologies may help unravel these social aspects.

To uncover and systematize these socio-material and socio-ecological profiles of energy landscapes is a major motivation for the present study. The aim is to gain a better understanding of what characterizes energy landscapes in general and to what extent they can be regarded as an expression of social inequality and injustice in the specific case of the German Energiewende. In view of dwindling acceptance, this national case study is especially intriguing: from a technological point of view, Germany can be described as a pioneer country in energy transition. Yet the socio-scientific analysis of the phenomenon 'energy landscape' has lagged behind the rich findings from the Anglo-Saxon region. Consequently, the opportunity was missed to consider the energy landscapes of the Energiewende as spatial expressions of the capitalist order, in which the powerful actors of German society are trying to reorient the foundations of the new energy system towards centralist, market-oriented structures while ignoring the sometimes devastating effects on the everyday lives of ordinary people; these effects are also an object of our study.

Furthermore, the study aims to close a research gap that has likewise been insufficiently discussed in the Anglo-Saxon literature: it concerns the conceptual question of whether and how energy landscapes can be distinguished from other landscapes and where exactly the lines of demarcation should be drawn. Without doubt, some studies have been able to make valuable contributions to a deeper comprehension of energy landscapes by identifying and categorising their essential features. However, the spatial scope of these features is unclear, especially in relation to other important landscape units, such as

recreational landscapes, protected landscapes and settlement landscapes, whose boundaries appear much more tangible. Only when the spatial amorphism of energy landscapes is attenuated and their actual dimensions become visible, can the issues of inequality and injustice be discussed in spatially distinct terms.

The study‘s central objective is therefore to compile the present findings on the socio-materiality of energy landscapes in the sense of a review and to reflect on them against the background of the German Energiewende. Here, the question is to what extent those actors who try to structure society in a capitalist manner can assert themselves with their linguistic codes and thus take a dominant position when it comes to permeating society with meaning. In particular, it must be investigated to what extent the spaces produced in the process reflect this powerfully consolidated effort and how they rise to material and immaterial images of hegemonic discourses. Finally, it is important to analyse how the operations of the energy transition‘s powerful actors intervene in the lives of ordinary people and how the latter react to the material and immaterial changes in the landscape.

By integrating the central findings into a critical-materialistic spatial concept, a more comprehensive understanding of the inequalities and injustices that are expressed in the perception, conception, and experience of energy landscapes is to be obtained. Additionally, it is important to point out the possibilities of differentiating energy landscapes from other significant landscapes.

For these reasons, in a first step (Section 2), theoretical approaches will be examined which recognize in technological artifacts the carriers of social orders, structures, and processes. Here we refer to current conceptual debates that connect landscape concepts with the concept of the ‘production of space’ [23]. On the basis of a literature analysis focusing on the most important scientific publications in the German-speaking and Anglo-Saxon region, we then want to assess the central findings on the socio-materiality of energy landscapes within Henri Lefebvre‘s concept of ‘production of space’ and examine them against the background of the German Energiewende (Section 3). The systematization of energy landscapes is based on the principal terms that Lefebvre [25] developed in his spatial theory: ‘perceived space’ (Section 3.1), ‘conceived space’ (Section 3.2) and ‘lived space’ (Section 3.3). The determination of the dividing line between energy landscapes and other significant landscapes follows this spatial concept. This approach intends to show which of these productions of space particularly stimulate social conflicts in energy landscapes. The question arises whether these conflicts have country-specific contours or are transferable to other national contexts. Section 4 discusses the central results and aims to identify approaches that integrate the local contexts of energy landscapes and help strengthen the confidence of local actors in the transformation process. Section 5 provides a conclusion.

The methodological basis of the study is a systematic literature review. Major online databases (e.g. Science Direct, Google Scholar) as well as subject-oriented websites of libraries (e.g. Online Public Access Catalogue) formed the basis of the literature search. Keywords were used that refer to the central research questions and hypotheses, the theoretical background, and the study area. The research was focused on the terms ‘energy landscapes‘ and ‘energy transition‘, from which content-related connections were sought with the sub-concepts of injustice, inequality, socio-materiality, and social constructivism. By linking these sub-concepts to Lefebvre's theory of ‘The Production of Space‘, the literature research was extended to those sub-concepts that are related to the three social spaces – ‘perceived, ‘conceived‘, and ‘lived space‘ – of the concept: spatial practices and routines, material landscape, territories, institutions, legislation, ownership, maps, discourses, spatial planning, symbolisms, emotions, identities, values, norms, cultures, and traditions. However, this expansion of the literature research was not concerned with these terms in general, but with their connection to the issues of energy landscapes and energy transition. Particular emphasis was put on the German context of the Energiewende. With regard to the types of literature and documents, the research concentrated almost exclusively on scientific books and journals, with grey literature playing a very minor part. The selected scientific literature originated primarily from the German and AngloSaxon regions. Care was always taken to ensure that the selected texts implicitly or explicitly include the terms mentioned above.

Starting with the bibliographies of the first identified essays, literature search was continued on the basis of the central terms and sub-concepts.

2. Theoretical background

We will first investigate theories addressing the social implications of technological artifacts. Reckwitz ([26], p. 290) speaks of the materiality of social life. Representational technology functions here as the realisation of social structures and processes ([19], p. 5f.). This means that technological embodiments emerge from human patterns of living together, communicating, and managing relationships and contribute to the reproduction and stabilization of social matters. Technology-related landscape conflicts can thus only be understood through a social science perspective – while social conditions, in turn, are to be understood through their materiality ([27], p. 415).

According to this perspective, energy transition represents a social transformation, whereby social change is the agent of technological change. Certainly, technological change has a repercussion on society and can accelerate the socio-economic and institutional transformation process ([28], p. 9). Yet the social transformation precedes the technological one. Technology is thus on the one hand a powerful expression of social change, and on the other hand a form of materialization that consolidates social differentiations ([19], p. 7). In their technological and material objecthood, energy technologies not only stand for the narrative of sustainable development set out by energy policy, demanding that sensible, enlightened citizens accept the disadvantages of energy transition. Rather, technologies and the energy landscapes that emerge from them embody the initially invisible social structures, processes, and practices of the spaces in which they are developed. They are therefore not only carriers of energy, but also bearers and mediators of social orders [16], so-called socio-technical systems. Within these systems, practices, knowledge, infrastructures, institutions, and coalitions of actors are mutually dependent. Social conditions hence define what a technology is ([29], p. 26f.).

This view follows the approach of MacKenzie & Wajcman [30], who in their anthology “The Social Shaping of Technology” launched a frontal attack on the dominant determinism of technology by considering technological artifacts as specific expressions of the respective social background. In this sense, renewable energies change landscapes not in an aesthetic perspective, but in relation to the underlying power relations ([31], p. 197).

Social constructivism according to Berger & Luckmann [32] offers a further theoretical point of reference. It states that social orders are not the result of a consideration of things as they are according to their nature, but how social groups explain and interpret things for their respective members. The actions that follow these interpretations become routine through constant repetition and thus generate an everyday knowledge that eventually becomes socially institutionalised. In view of the social constructions of energy landscapes, the locations of the technological installations must be brought into focus, because there are often strong emotional ties between these places and the people living there. These ties are examined more closely by the concept ‘sense of place’ ([33], p. 535). In addition to ‘place attachment’, it includes the notion of ‘place identity’, which describes the effects of the physical-material and symbolic-immaterial qualities of a place on the self-perception of an individual or a group.

All of these theoretical perspectives can be perfectly combined by means of Henri Lefebvre's concept ‘production of space’ [25], because here the material landscape and the spatial practices, institutions, territories, identities, cultures, symbolisms, and images that emerge from it are understood as interdependent elements of a social reality. In this context, interest is focused on how people create their own ideas of society and how they also produce social spaces in the course of this production of social relations ([34], p. 143ff.). Krauss ([31], p. 196) also sees people as “space-creating beings” who cannot exist without creating “self-animated spaces”. Landscapes hence become definitions of our self ([35], p. 2). Lefebvre ([25], p. 39) has condensed these definitions into ‘perceived space’, ‘conceived space’, and ‘lived

space'. In this concept of "multiple spatialities", Calvert et al. ([23], p. 193ff.) identify the opportunity to link the material and productive dimensions of energy landscapes with the representative and discursive ones.

Pasqualetti and Stremke ([22], p. 95) emphasize that human lives take place in space and have a definite relation to specific places, which is not only physical-material, but also mental-spiritual. Hence, places are not per se endowed with meaning. Without human intervention, they would be inexperienceable and unstructured. According to this understanding, energy landscapes can only be a product of discursive practice. Apart from material goods, human acting also produces relationships, symbolisms, emotions, cultures, art, knowledge, values, traditions, and norms. These immaterial products give social meaning to the prediscursive locations of the world and thus also to the energy landscapes emerging from them. As stated by Lefebvre ([25], p. 28), this meaning is produced by language, dominated by the linguistic codes of those actors who attempt to structure space in a capitalist manner. The social spaces produced in the process reflect this effort which is consolidated by power, hence becoming material and immaterial images of hegemonic discourses. In this sense, the emerging energy landscapes represent the strategy pursued by the ruling class to orientate its property relations, laws, and institutions in such a way that the capitalistic society is (re-)produced. In this context, Lefebvre ([25], p. 49ff./57) refers specifically to the rather abstract 'conceived space', which is described as the space of both capitalism and bourgeoisie, since it is within this space that labor relations are organized. This space has strong effects on the living conditions of those people equipped with less power and – as the study at hand exemplifies – are forced to experience the construction of energy landscapes in a passive role. Therefore, there is an antagonism between a dominant 'conceived space', which is about calculations, quantifications, and goods, and a 'lived space', which tells of the lives of ordinary people living in the dominant spaces. In the context of this 'lived space' people's reactions to the transformation of landscapes through capitalist appropriation become visible. Applying Lefebvre's concept hence not only promises insights into the way in which energy landscapes become locations of capitalist (re)production. Moreover, it opens up the opportunity to get to the roots of resistance by analysing how those affected by energy infrastructures react to the decisions of the energy transition's powerful actors.

For these reasons, it seems worthwhile to transfer the spatial concept of Lefebvre to energy landscapes in general and German energy landscapes in particular. In this regard, 'perceived space' refers to the interaction between material landscapes and spatial practices of energy transition (Section 3.1). 'Conceived space' denotes what has been conceived by persons, the focus being on the production of territorial structures and the formation of institutions that legitimize these constructs through laws, land use rights, spatial planning guidelines, and maps (Section 3.2). Spatial identities, symbolisms, values, cultures, and also art belong to 'lived space', which thus arises from a process of transcending social conditions (Section 3.3).

3. Production of energy landscapes

3.1. Perceived energy landscape – Material landscape and spatial practices

In the context of 'perceived space', the focus is on the transformation of spatial practices and routines that emerge from the new ways of producing, transporting and consuming energy. In this respect, Brücher [13] points out that in the course of the energy transition, humanity is returning at least in part to the spatial practices that shaped energy production in pre-industrial times. Primary energy is thus once again being drawn from the earth's surface, albeit with more powerful technologies, but still by tapping energy flows with low energy densities. The consumption of land by renewable energies is therefore disproportionately higher than it is the case with the extraction of belowground fossil fuels ([23], p. 191). By successively enriching rural areas with post-fossil technologies, the energy transition leads to a transformation of landscapes that is visible from far away. McDonald et al. [36] emphasise that the expansion of renewable energies based on climate protection has led to a disproportionate consumption of land, an "energy sprawl" [37], which has become the decisive driver of land use change [38]. Pasqualetti & Stremke ([22], p. 94f.) place these strong landscape changes in the context of humanity's growing hunger for energy and therefore speak of energy landscapes, which the authors typologize on the basis of the dominant energy resource

(substantive qualification), the intensity of this spatial dominance (spatial qualification), and on the basis of their temporal permanence (temporal qualification). However, this is not only about landscape as a panorama of a natural scenery ([39], p. 337), but also about an area perceived by humans. An area's character hence results from the interaction of natural and human factors [40].

Energy landscapes are increasingly spoken of as a matter of course ([27], p. 412), but it is hardly clear what exactly is meant by this term. For Pasqualetti ([41], p. 34), energy landscapes are "eye-catching landscapes", with which cultural landscape phenomena emerge that break up and expand the previous categories of landscape. These include not only the scenically conspicuous wind and solar power plants ([42], p. 9), but also biomass cultivation, which with its energy forests of willows and poplars has established a new area category between agriculture and forestry and has opened up access to European cultural landscapes for alien cultural species, such as the Chinese silvergrass originating from Southeast Asia ([43], p. 24). Faller [44] emphasises that spatial practices for the energetic utilisation of biomass are excellently integrated into existing agricultural practices for food and feed production and have become alternative sources of income for German farmers who suffered from the fluctuations in world market prices. In combination with the strong political support for agriculture in Southern Germany, this has led to the highest density of biogas plants in the world (cf. Fig. 1). The resulting landscapes may appear strange because of the numerous fermenters, which are reminiscent of central asian yurts. Pasqualetti ([41], p. 33) speaks of "odd landscapes", which literally turn habitual perceptions upside down. This is also the case in those places where large lakes are no longer located in the valleys as usual, but diametrically on the top of a mountain as an energy storage, or where wind turbines developed for the purpose of rotation are at a standstill ([45], p. 79).

The fact that these irritating energy landscapes were hardly presented in the form of an aesthetic vision is now taking revenge. In consequence, the landscape-aesthetic implications of the Energiewende have developed into a significant factor of resistance ([46], p. 223). Linke ([27], p. 415) sees the increased importance of landscape aesthetics as being rooted in postmodernism, in which aesthetics were upgraded, making it impossible to reduce landscapes to functional aspects. In addition to visual qualities, the new energy landscapes have auditory effects, such as noise emissions and infrasound ([47], p. 48f.), as well as olfactory effects, such as odour emissions from biogas plants ([41], p. 39). However, landscape intrusions also take place beyond the perceptible, which van d. Horst ([48], p. 251f.) calls "energy invisibility". This involves not only the externalisation of social and ecological costs to distant storage and extraction sites of fossil fuels [49], but also climate-relevant emissions and radioactivity. The latter caused a great stir in Germany when an epidemiological study showed that there is an increased probability of leukaemia in the vicinity of German nuclear power plants [50].

Renewables are also associated with a wide range of health effects (e.g. headaches, sleep disorders) [51]. Although their symptoms are medically proven, as is the case with 'wind-turbine syndrome' (e.g. high blood pressure, epilepsy) ([43], p. 30), a causal connection of these health disorders with energy technologies could not be empirically proven ([47], p. 49). It is noteworthy that health exposure to energy transition is more pronounced in certain population groups and shows spatial patterns in this respect. The line of segregation runs along ethnic and financial characteristics. In this sense, new energy landscapes reinforce existing patterns of marginalisation ([52], p. 180f.). The social constructs on which these marginalizations are based and how they are reproduced by laws and institutions in Germany will be discussed below.

3.2. Representations of space

3.2.1. Conceived energy landscapes for the reproduction of social conditions

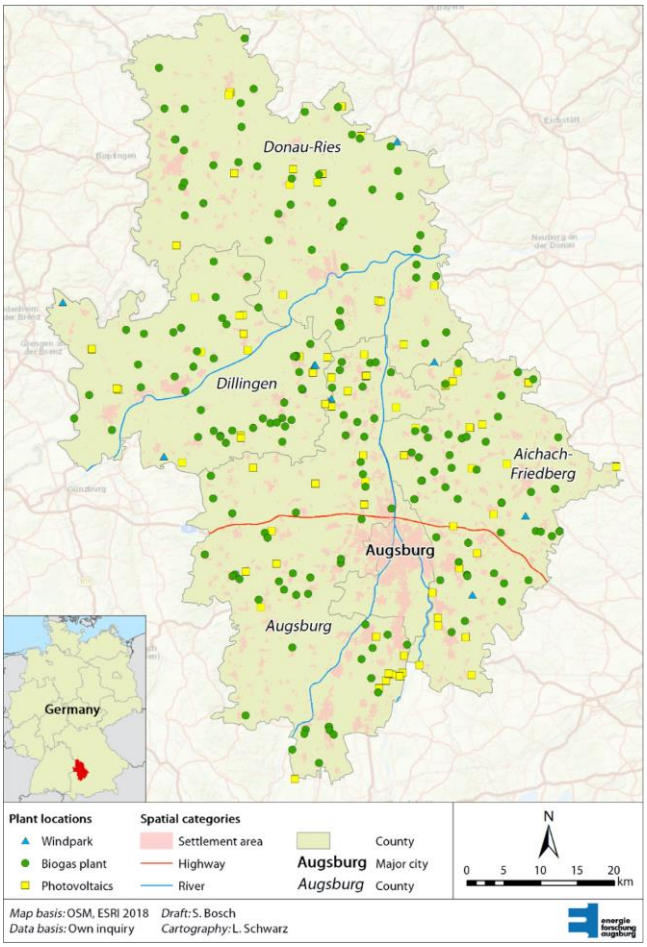
In the context of 'conceived space' it is analysed which territorialinstitutional structures are constructed in order to harmonize the special characteristics of renewable energies with the existing power structures and to enable a reproduction of social conditions. First of all, it should be noted that in comparison to fossil fuels, renewable energy resources are more evenly distributed over the territories. Furthermore, energy production covers a much larger area, since the energy density of renewable energies is lower [13]. These

circumstances make it difficult to secure, control and monetise renewable resources ([53], p. 6). Nevertheless, power asymmetries and the resulting injustices are also part of renewable energy landscapes [54]. The visual expression of power in energy transitions are energy potential maps that are produced on a large scale. They cast the goals of energy policy in spatialadministrative units and reduce the diversity of subspaces to controllable categories. In this context, social sciences are not infrequently instrumentalised to shed social constraints for energy policy aspirations ([55], p. 1108). E.g., social issues are manipulated according to political interests ([56], p. 14), decoupled from national goals and shifted to the responsibility of local politics ([57], p. 222f.).

Zimmerer ([58], p. 465ff.) sees this as the implementation of neoliberal economic methods that reduce landscapes to a production factor. Through the economic control of energy landscapes, social control can be exercised ([59], p. 491) and lead to the development of an "energy underclass" ([60], p. 441). Thus, within the neoliberal logic, the expansion of renewable energies takes place at locations that have already suffered severe technological intervention and ecological degradation [61]. Bickerstaff ([60], p. 439) speaks of "peripheralization" and explains that areas that are politically powerless are frequently targeted by the neoliberal calculus of locations for power plant construction. This well-established, imposed familiarity with technicised landscapes leads to a "fatalistic acceptance" of energy landscapes among residents who are excluded from decision-making processes. Bridge et al. ([52], p. 176) confirm that new technologies do not create new social asymmetries, but rather reproduce long-standing inequalities and thus perpetuate them. However, when undertaking a sustainable energy transition, not only the modernization of the energy system should be considered, but also the overcoming of unjust social structures [62].

Problems of this kind can be observed particularly in the Global South, where the expansion of solar power plants is repeatedly associated with the expropriation of indigenous population groups and has thus led to the term "energy dispossession" ([63], p. 92). In the western industrialised countries, social criticism refers more to the unbalanced decision-making structures ([60], p. 442), which would reveal a democratic deficit [64]. Next to opposition to imposed large-scale projects [65], civil society is reacting to this by initiating energy projects at the municipal level ([66], p. 505), creating a completely new territorialinstitutional category of

energy landscape. This form of ‘eco-decentralism’ is based on the assumption that energy landscapes have



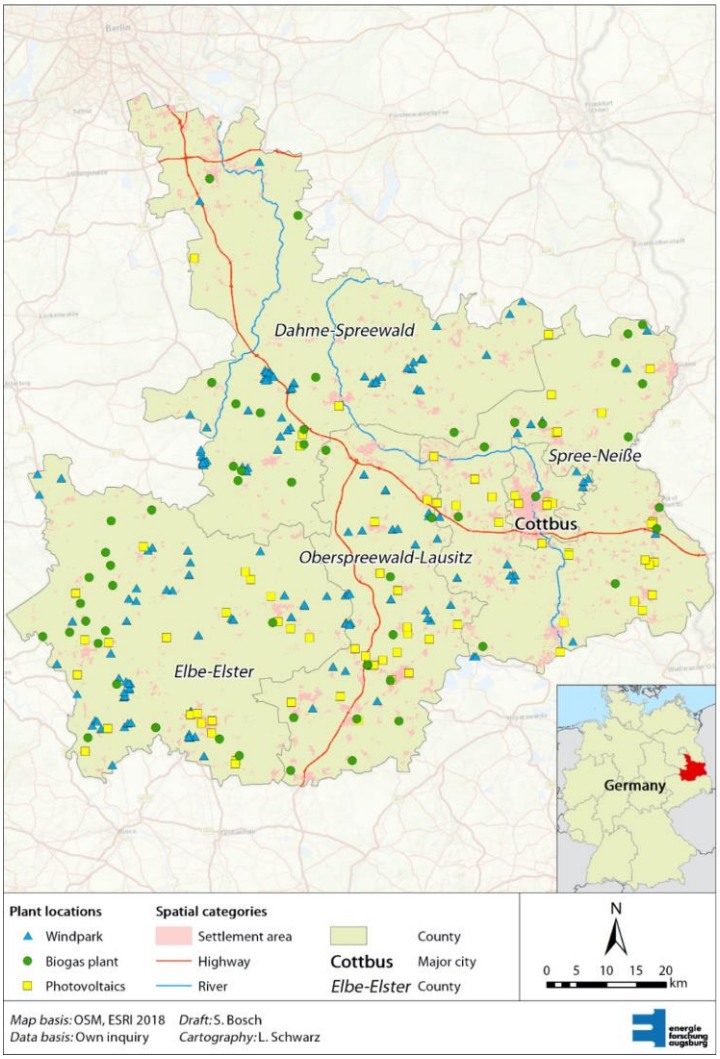
to take into account the carrying capacities of local ecosystems and that this

Fig. 1. Deployment of renewable energies in Southern Germany [123].

can only be guaranteed by local supply structures. The exceeding of ecological limits is therefore always the consequence of centrally controlled, capitalist power relations ([67], p. 341f.). However, the success of ‘community energy’ – see [68] – is ambivalent. For although it sees itself as an ideological and territorial-institutional contrast to centralised large-scale projects and seems to turn consumers into responsible citizens [69], the possibility of initiating citizen-oriented energy projects can also be regarded as a material concession by the ruling class. The latter pursues the goal of achieving the reproduction of the capitalist class not through oppression. Rather, it seeks to integrate community energy into a predominantly centrally controlled, technocratically oriented energy transition ([70], p. 379). Moreover, the economic and ecological advantages of small-scale energy production as in the context of community energy, have been partly refuted ([67], p. 339). Nevertheless, the terms ‘local’ and ‘community’ are still used uncritically as spatial categories of the energy transition and function as a projection screen for certain wishful thinking about social conditions ([71], p. 23).

Even so, Bridge et al. ([52], p. 193) see in the strong participation of the public a new form of democracy, an ‘energy democracy’. It is not clear what exactly is meant by this ([72], p. 143). Some see it as a desireable social state, which will be reached at the end of the energy transition. For others, energy democracy is a process that is already underway, in which questions of ownership and control of energy are negotiated on a daily basis ([71], p. 20). The term thus shows parallels to ‘energy justice’ [73], ‘renewable energy (in-)justice’

[74], ‘social and environmental justice’ [75], and ‘energy poverty’ [76], as they all stand for the redistribution



of power with the goal of more equality. Schwarz

Fig. 2. Deployment of renewable energies in Eastern Germany [123].

([77], p. 9f.), however, uses a case study of wind energy project development in Southern Germany to show that even the less influential citizens, who always assume that the dominant actors have their own interests at heart, are not necessarily striving for more justice and democracy, but also for the implementation of their own will.

3.2.2. Territorial-institutional constructions of the Energiewende

In a densely populated country like Germany, the spatial integration of renewable energies represents a major planning challenge. Important authorities for the development of spaces are the three planning levels ‘federal spatial planning’, ‘regional planning’, and ‘municipal planning’, which form the system of spatial planning [45]. The planning relevance of renewable energies results from the Spatial Planning Act, according to which the municipalities and districts are to create the spatial prerequisites for climate protection and energy transition. The conceptual background is provided by the leitmotif of sustainable spatial development, which stands for harmony between the ecological, social, and economic functions of a landscape. It is the task of the planning authorities to mediate between energy technologies and the competing demands for space. This involves drawing up legally binding maps and plans in which specific functions (e.g. priority areas for wind energy) are assigned to certain subspaces [18].

The Renewable Energy Sources Act (EEG) is another territorial-institutional instrument of the Energiewende. It aims to develop renewable energies primarily on pre-burdened areas. The areas in question are those that have already been used for residential, commercial, military, or infrastructural purposes or are in the immediate vicinity of such areas [78]. For example, solar plants only receive financial support ways or railways. In the case of wind energy, the strategy is also to use sites that have already been industrially transformed. The focus is on areas with dumps, landfills, former open-cast mines, military wastelands, and areas close to motorways or railways [79].

Closely linked to the use of pre-burdened sites is the federal government's strategy of conserving ecologically valuable areas. These areas ensure the necessary diversity of ecosystems, species, and genetic make-up ([80], p. 483), which is why areas that are of above-average importance in terms of nature, water, and species protection are sheltered from the technical interventions of the energy transition [81]. Bridge et al. ([52], p. 335), emphasise that the idea of unspoiled areas could infiltrate planning levels and the underlying laws. This led to a defensive attitude towards renewable energies in Germany, which found its conceptual expression in destructive planning structures ([45], p. 21). Moreover, the restrictions on land use in Germany are unbalanced. Particularly with regard to the use of biomass for energy generation, there are major ecological reservations due to the ploughing up of grassland in many regions of Germany [82]. Yet at the regional planning level, the ecological impact of biomass cultivation is hardly regulated by law – while very high demands are made on the ecological sensitivity of wind energy deployment.

The focus on pre-burdened areas is understandable in so far as less resistance from the population can be expected in these areas. After all, the connection between energy consumption on the one hand and the provision of the necessary energy sources on the other hand may have penetrated deeper into the consciousness of those people who live in areas with industrial character. However, this fact is not sufficient to justify developing energy projects only there: it ignores the cultural significance that landscape has for all people in all regions of Germany ([83], p. 9). Relegating pre-burdened spaces to a position of low significance in a hierarchy of landscape value, thereby justifying their unchecked transformation through energy technologies, is therefore highly problematic. Neither can the assumption be generalised that less resistance can be expected there. E.g., Nölting et al. [84] found that the population in Eastern Germany is fundamentally sceptical about landscape changes. Becker et al. ([85], p. 49) explain this with the collective experience of economic decline prevailing there, which after the German reunification led to high unemployment and experience of the failure of industrial projects. This could have provided a breeding ground for protest attitudes towards the Energiewende.

One exception is the former lignite region of Lower Lusatia, where large wind and solar parks became central elements in the redesign of ‘post-mining landscapes’ (cf. Fig. 2). The energy transition was intended to shake off the negative image of the former mining region as an economic, demographic, and ecological problem area of reunited Germany. The appearance of the first wind turbines was therefore seen by the citizens as the first positive development in the region since the fall of the Berlin Wall. With the new technologies, hopes for a better future germinated, although the effects on the labour market were small. However, the increasing repowering of wind power plants with much higher towers is now leading to increased resistance from tourism and nature conservation, who now have an equal interest in the landscape potential of Lower Lusatia and are therefore fighting against focusing the Energiewende on pre-burdened regions ([86], p. 38.). Schöbel ([45], p. 22) even considers these territorial-institutional structures to be unconstitutional, since according to the constitution, homogeneous infrastructural, social, economic, cultural, and ecological living conditions must be established in the sub-areas of Germany. Structurally weak regions would therefore have no less right to a technology-free landscape than more beautiful, structurally stronger regions.

In the course of sustainable development, it will likely be difficult to maintain the energy consumption of the whole economy at the landscape costs of only a small number of regions. It is worrying that behind landscape-related spatial categorisations not only efforts with regard to biodiversity are expressed, but that economic calculations are also turned into powerful spatial planning constructs [87]. Behind the landscape distinction,

which ascribes above-average social significance to certain landscapes, a socio-economic segregation process takes place at the expense of structurally weak areas. From the perspective of Harvey [88], such spatial constructs stand in a capitalist order: local resources – in this case the aesthetic and ecological value of a landscape – are controlled by powerful actors who instrumentalise these resources by means of arbitrary spatial categorisations. An example for this are the efforts of local politicians to prevent a planned wind farm in the German federal state of Saarland: they appealed to the European Union to extend the boarders of a large-scale bird sanctuary so that it included the planned wind area [89]. In addition to nature and species protection, the apparent recreational effect of landscapes is repeatedly instrumentalised against the expansion of renewable energies. Especially in Southern Germany, tourism associations have thus been able to effectively prevent the rise of wind energy [90].

3.3. Lived energy landscapes – Representational space

3.3.1. Symbolisms

In the context of 'lived space', it is basically a matter of analysing the landscape-related values and ideas of landscape that arise from a process of transcending places ([23], p. 193). Symbolic meanings have a strong impact on the perception and valuation of energy landscapes. A striking feature is the polarisation between narratives that see energy landscapes as the realisation of a carbon-free future and narratives in which the new energy landscapes are the material expression of inefficient, publicly funded political measures ([47], p. 57). In Germany, this polarisation is reflected in the energy transition-friendly party 'Die Grünen' and the energy transition-critical, right-wing populist 'Alternative für Deutschland'. Fraune & Knodt [91] confirm that right-wing populist parties in particular are challenging climate protection measures and the related transformation of the energy system, thereby fiercely attacking the parties of the centre that are committed to climate protection.

Historically, energy landscapes symbolise a positive civilising achievement and development. The hundreds of thousands of windmills in the Great Plains in pre-industrial times are an example of this. It is remarkable that this strong mechanisation of landscape not only did not provoke any resistance, but was positively received by the local residents, because the impending emigration of the farmers could be prevented ([92], p. 216). The windmills were described as "beacons of civilisation" and as "bearers of hope" for an economically hard-pressed, meagre agriculture. The technical facilities were perceived as a material expression of progress and prosperity and were welcomed as "neighbours" and "benign sentinels" ([41], p. 15f.). Electrification and the establishment of interconnected grids during the Second Industrial Revolution, which gave many people access to electrical energy, also had a strong positive symbolism, as they were not only an important factor of national identity and state-building, but a central characteristic of modernity. Van d. Horst ([48], p. 255) speaks of the "grid state", which also became the central symbolism in the expansion of gas and oil pipelines. Energy production thus becomes a means of centralisation and powerful structuring of identity and territorial claims, as was the case with the instrumentalisation of hydropower under Franco [93] or with the significance of nuclear energy for the French self-image of (energy) independence ([94], p. 7429).

These identity-giving national symbolisms of energy landscapes have been lost in Germany. In the search for reasons, cultural-critical approaches come to the fore, which tell of the uprooting and alienation of modern human beings, who suffer under a technocratic rule, even from an idolisation of the gigantic. This giganticness must lead to selfdestruction, since the human beings themselves are small. Technisation in this case symbolises a destructive path of society's development, and the solution of the ecological crisis could thus not lie in technological progress but in pre-technological ways of life ([67], p. 343ff.). The renewable energies, which in the course of the Energiewende suddenly penetrate the construction of a seemingly harmonious world, can in this sense only be seen as alien bodies in the landscape. Schweiger et al. ([95], p. 434f.) describe the resistance against the newly emerging energy landscapes as an attempt to restore the original harmony.

But the question arises to which extent energy technologies actually impair the harmony of a landscape. Dusyk ([66], p. 510) explains that the state of harmony is threatened when local ties and local identities are jeopardised. Protest, which usually occurs only locally, is a form of site-specific protection [96,97,98]. It is striking that religious symbolism plays an important role in this. For example, the strong resistance to wind turbines is due to the fact that their prominent verticality breaks the usual horizontal division of rural areas and visibly inscribes profane, urban architecture into the landscape. Wind turbines thus occupy the horizon in a way that was previously only permitted for religious buildings. This gives the energy transition a pagan character and fuels the fear of a coup against religious architecture ([47], p. 47,57). Furthermore, the authors point out that this combination of general horizon pollution and penetration of the sacrosanct horizon is perceived and fought as a threat to territorial and spiritual identity. The apparent attack on the religious symbolism of the 'tower' through secular, culturally neutral architecture is by no means new, but already shaped social debates at the end of the 19th century when the first skyscrapers were completed in the United States. European urban planners, for example, rejected the idea of introducing buildings next to which churches were diminished. Criticism was likewise directed against the clock towers that were widespread in the British Empire and Ottoman Empire, which as new cultural landscape elements also rivalled religious buildings ([99], p. 123,463). In Germany, the cultivation of energy crops is also a point of strong religious criticism, since the 'daily bread' is a central symbolism of Christian culture ([43], p. 37). Within this deep-rooted value system, bread stands for food in general. Against this background, the energetic use of bread grain was irritating and could be understood as ignorance of world hunger. Religious movements, however, are not always on the defensive against the Energiewende, but can also become drivers of sustainable development, especially at the local level, through campaigns and the communication of values, as Koehrsen [100] demonstrates using the example of a North German city (Emden).

For a few decades now, ecological symbolism has also played a major role in the evaluation of energy landscapes. After all, the energy landscapes of the mineral economy have been accompanied by unprecedented environmental destruction [101]. It is noteworthy that until the publication of Meadows et al. [102], ecological issues did not find any significant entry into social debates, and landscape destruction was rather considered an economic necessity and "curse of progress" ([41], p. 17). In the meantime, however, renewable energies have come to function as "new visual reminders" ([103], p. 144). Through their presence they confront us with the consequences of an unbridled energy demand and raise awareness of the necessitiy to no longer externalise the ecological consequences of energy supply. But this symbolism also triggers resistance, as some people want to avoid or delay change because they see the risk of change as higher than the risk of stagnation ([47], p. 50f.). Another problematic aspect of ecological symbolism is its ambiguity, since while renewable energies offer a solution to reduce the global CO2-emissions, at the local level they pose a significant threat to habitats of fauna and flora ([52], p. 189). This inner-ecological conflict is particularly evident in wind energy. Proponents see its expansion as a positive landscape development and an opportunity to phase out dangerous nuclear energy. Opponents, on the other hand, speak of the disfigurement of cultural landscapes deserving protection, the destruction of retreat areas for endangered animal species, and possible health damage for local residents ([104], p. 126f.).

The impact of such narratives depends on the decision-making structures on which energy projects are based. Projects initiated on a municipal basis have a much greater acceptance than those initiated by supraregional investors and large corporations ([71], p. 22). Still, the symbolism of community energy goes hand in hand with the symbolism of small scale and proximity, as a premise for a successful human-nature relationship and as a natural measure of good living ([67], p. 331ff.). Behind this lies the human desire for a transparent and understandable world, which is endangered in the course of globalisation. At this point there is therefore a strong connection to the symbolism of home [105], since homeland care also places the protection of the local natural environment in the foreground and identifies modernisation and globalisation as the causes of a loss of identity. The ecological crisis and the crisis of human identity thus combine to form a concept that reflexively forces the energy transition into a local corset. But in fact, the successful implementation of technologies depends on managing to establish links to local culture, as is the case in Northern Germany with

the expansion of wind energy. E.g., the coasts of Northern Germany are mainly artificial landscapes that have been designed by humans and wrested from the sea by impressive and innovative technologies ([31], p. 196). This has facilitated a culture in which natural elements are symbolically integrated and in which the harsh characteristics of nature are used to develop landscape ([103], p. 149). Wind energy can be excellently embedded in this culture of productive use of the natural elements. Surveys have shown that lighthouses and wind turbines are symbolic of a Northern German landscape type ([43], p. 24).

For Northern Germany, it is thus evident that renewable energies can be integrated on the basis of existing categories of landscape perception and evaluation. If this is not the case, as in the South, the cultural categories and practices which then reveal themselves behind the landscape conditions are exposed to controversy and challenged. Accordingly, when drawing up regional energy concepts, the specific landscape tradition must be explored and disclosed ([29], p. 37).

3.3.2. Emotions

Of great importance is the phenomenon of energy landscapes as 'emotional landscapes' ([47], p. 47), in which immaterial meanings are attributed to physical-material elements on the basis of emotions ([27], p. 410). Acceptance is therefore not a philosophical debate struggling for truth and knowledge ([69], p. 433). Rather, the phenomena of resistance to and support for the energy transition are based on subjective feelings [106], which find expression in constructed patterns of argumentation ([107], p. 45). Emotionally defensive attitudes towards new technologies are particularly common in their introductory phase and initially can hardly be contained by verifiable, rational perspectives. Great and rapid technological progress is fuelling concerns about an all too reckless belief in progress that jeopardises the very foundations of a society ([47], p. 47). Resistance could in this sense be understood as a warning appeal, which, as in the context of cloning and genetic engineering, seeks to stimulate critical opinions on new technologies. Yet this overlooks the fact that energy-related landscape impacts are not new phenomena, but rather return to the polluter after two centuries of externalisation ([41], p. 29). The invisibility of fossil-nuclear energy landscapes ([48], p. 251f.) gave the impression that energy production is an irrelevant process in landscape terms.

Consumption-oriented service economies such as that in Germany, which are characterised by a strong externalisation of negative costs, tend to have an above-average resistance to renewable energies because they want to suppress the consequences of their own excessive lifestyle ([47], p. 54). The strong resistance in areas with a high-quality landscape is often recruited from wealthy in-migrants who have only recently relocated to rural areas and have little connection to the communal roots there ([33], p. 537f.). As a result, the relationship between place of residence and environment in Germany has changed significantly in such a way that rural areas no longer secure livelihoods, but rather the status of an individual and cosy way of life ([83], p. 9).

Parts of German society also reject scientific teachings on the climate-related necessity of the Energiewende. Too often in the history of humankind there has already been a hasty, actionist-driven large-scale environmental alarm ([108], p. 68). Fatally, a group of climate researchers who see human beings as the central cause of recent climate change has been exposed for poor scientific practice. Although 'Climategate' was only an academic exception, the incident not only discredited climate protection strategies, but also mobilised opposition to renewable energies ([52], p. 188). Yet science seems to have lost its central position within Western societies even before that. It has been replaced by emotions and taste, and has given rise to structural hedonism and narcissism ([47], p. 54). The actual purpose of the Energiewende is faded out in the debates in favour of emphasizing experiences of loss ([43], p. 24). If that is the case, the justification of energy landscapes on the basis of rational arguments that appeal to human reason must fail ([95], p. 438).

The emotional character of discourses thus offers an arena for those voices that twist the cause-and-effect relationships. For example, the high mortality rate in birds is attributed solely to wind turbines, while much weightier causes such as cats and window panes are faded out ([109], p. 143). Even the argument, which has been launched again and again, that tourists would stay away from a tourist destination because of wind

energy landscapes, could not be empirically proven so far. Aschenbrand & Grebe ([110], p. 534) explain that tourists are accustomed to not having their stereotypical landscape expectations fulfilled and therefore regard wind turbines as normal landscape elements of a tourist destination. However, those harmful health effects of wind power plants which have not been empirically proven, are also considered given facts for large parts of the population. As part of political campaigns against renewable energies, politicians take up people's medical concerns in order to win elections ([109], p. 141). They ignore the fact that the advent of new technologies has always been accompanied by mysterious diseases (e.g. train sickness, sick building syndrome). Remarkably, such technology-specific symptoms of disease in a society disappear again after a period of habituation. The term 'social diseases' is applied ([47], p. 58ff.), i.e. diseases that are real in their symptoms but have a sociosomatic character and are culture-dependent. The intensity of social diseases depends on the speed with which technological changes occur ([43], p. 24).

Renewable energies have conquered rural areas without warning and robbed people of the reassuring illusion that landscape is characterised by permanence ([48], p. 252). Therefore, these landscape changes will be critically regarded at first. Over time, however, this can change and even lead to an idealisation of the newly emerging landscape elements, because social constructions of energy landscapes can be revised at any time ([27], p. 415). Especially in the German energy sector, this cultural transformation, in which Sijmons [111] sees an emotional transformation driven by cultural actors, is easy to understand. The technical elements of hydropower, which have long been part of the German cultural landscape, are now strongly valued and romanticized as cultural monuments (e.g. canals, water mills) as objects of technical history and monument preservation ([43], p. 23). This emotional transformation can also be felt in the example of the old industrialised regions of Western Germany, whose aesthetic potential has been uncovered for many years and advertised in the context of UNESCO World Heritage sites (e.g. Zeche Zollverein) [112].

3.3.3. Morality and ethics

Energy landscapes have become "socio-politically charged arenas" ([103], p. 144), in which the fundamental struggle against and for energy transition is carried out. Some environmentalists are pressing for the continued existence of nuclear power plants and the expansion of highly efficient coal-fired power plants, arguing that climate protection cannot be achieved through technologies that are controversial in terms of landscape aesthetics and, moreover, ecologically questionable ([47], p. 46). Proponents of nuclear energy also point to its good "carbon performance" ([52], p. 185), with the aim of repositioning this technology in energy landscapes. This strategy would almost have worked in Germany if the Fukushima disaster had not occurred in 2011.

Nevertheless, the fossil-nuclear "hegemony project" ([70], p. 381ff.) is still being pursued and supported in Germany by playing down the ecological consequences, praising the efficiency of the technologies, emphasising the security of supply of power stations, and warning against energy poverty within a renewable energy system. The supporters of the Energiewende, on the other hand, focus on the consequences of global warming, the reduction of energy dependency, and the opportunities for exports and the labour market. Both sides refer to Germany's triangle of goals of a secure, cost-effective, and environmentally friendly energy supply. And yet the goals are used to pass off particular interests as general will. Vogt ([113], p. 94) points out that despite efforts to achieve sustainable development, promoters of energy transition put no emphasis on moral aspects. However, since the Energiewende is primarily an ethically motivated project, it is precisely this absence of morality that threatens its success. Jenkins et al. ([114], p. 71) speak in this context of a "moral vacuum" that has paved the way for an energy justice movement. According to Sovacool ([115], p. 3), an ethical debate on energy transition should therefore begin with the question of what purposes the effort involved in transforming the energy system serves, and what moral principles lie behind them.

If morality is not a central benchmark, then the focus is on individual interests: the strategy of believing oneself to be on the side of rationality, science, and good science is used in order to be able to distinguish oneself from irrationality, non-science, and bad science ([52], p. 186). In this way one's own particular

interests become universalised ([70], p. 379). This does not only apply to the opponents of the Energiewende, as the proponents likewise ignore the ecological problems by attesting renewable energies per se sustainability and repeatedly compare them with the ecologically even more questionable fossil fuels. There are also ambiguities as to whether actors adopt an anthropocentric or physiocentric perspective and whether the landscape conflicts of energy transition are about protecting landscape as a cultural achievement or preserving a clean natural environment ([108], p. 63). Thus, representatives of an anthropocentric perspective see the new technologies as a materialisation of the promise of economic growth that generates new jobs, large tax revenues, and low energy prices [116]. Vogt ([113], p. 101) even equates the overcoming of the carbon-based economy with the abolition of slavery and the outlawing of child labour. In contrast, advocates of a physiocentric perspective prioritise the interests of animals, plants, and ecosystems [117].

A look at German history shows that the origin of the Energiewende lies in the anti-nuclear movement of the 1970 s ([118], p. 5) which was driven by civil society. Remarkably, at that time it was not the type of energy production that was challenged, but the authoritarian actions of government and technocrats. Therefore, the question of the democratic legitimation of energy landscapes is the moral foundation of the struggles over the German way of energy production.

4. Discussion

4.1. Inequalities, injustices and suggestions of improvement

The study has shown that Lefebvrés concept of ‘production of space’ is suitable for elucidating the diversity of German energy landscapes and for better grasping the inequalities and injustices of the Energiewende in its origins and construction. It became clear how a rampant capitalist mode of production of space affects people's everyday lives in the context of the Energiewende and what social reactions are associated with centrally managed energy infrastructure. With regard to ‘perceived space’, it could be shown that existing spatial practices in agriculture were an essential prerequisite for the establishment of ecologically questionable bioenergy landscapes in Southern Germany. Contrarily, spatial practices concerning wind energy were hampered by regulations with much higher demands regarding social and ecological sensitivity, which is in stark contrast to Eastern Germany (cf. Fig. 1 & Fig. 2). But the application of Lefebvrés approach of ‘conceived space’ revealed that the germ of resistance to the Energiewende actually lies primarily in its territorial-institutional foundation. The latter is reinforced by the powerful actors of the Energiewende (e.g. politics, environmentalists, in-migrants). To promote the development of renewable energy exclusively in pre-burdened and structurally weak regions, while sparing beautiful, structurally strong, and energy-intensive regions, is not only a stark contradiction to the constitution. It has also led to strong spatial disparities in terms of actual and perceived quality of life and has increased social tensions in a way that now challenges the Energiewende as a whole. The social polarisations that result from this were demonstrated in the context of ‘lived space’. In German politics, this polarisation is reflected by the energy transition-friendly party ‘Die Grünen’ and the energy transitioncritical, right-wing populist ‘Alternative für Deutschland’.

The application of Lefebvre’s approach revealed that energy landscapes can only be sustainable if the corresponding technologies reflect both justice and a universally acceptable moral stance. In addition, they must be connectable to the local symbolic and emotional characteristics of locations (cf. ‘lived space’). The ‘emplacement strategy’ is of great importance in this context. It captures the deeper meaning of places and assigns suitable technologies to certain local identities in the sense of ‘placemaking’ [119]. Parameters such as ‘beauty’, ‘closeness to nature’, ‘uniqueness’, ‘justice’, and ‘appropriateness’ are context-dependent. Accordingly, spatial identities can only be captured with the help of the perspectives of local residents. Stremke & Picchi ([21], p. 368ff.) therefore favour a participatory design process for the creation of energy landscapes. This not only helps to identify the local conflicts of objectives, but also allows the experience of landscape loss in ‘lived spaces’ to be recorded in advance of changes ([120], p. 87).

Furthermore, it is important to develop socio-designs that enable accepted local narratives to be updated or reinterpreted with the new energy landscapes. The narratives have to break away from purely functional

aspects (cf. ‘conceived space’) and pick up on symbolisms that generate positive associations among the population. There are numerous possibilities for this: recommunalisation, local pride, energy independence, regional resources, local economy ([95], p. 435f.). Landscape planners can act as producers of discourses through “persuasive story-telling” ([104], p. 128). A “progressive localism” ([67], p. 349) should be aimed for, which is not about an ideological disavowal of the big scale. Rather, it aims at overcoming the perspective on smallscale model as closed systems. Local identities must be receptive to global solidarity and must not categorically oppose spatial changes that express this solidarity. Energy democracy encompasses not only local contexts but also regional, national, and international contexts and, moreover, the links between these levels ([121], p. 303). It stands for a universal reason and for the lived experiences of various actors ([71], p. 23).

4.2. Demarcation of energy landscapes

The analyses have shown that energy landscapes can basically be delimited in two ways. On the one hand, the focus can be directed to the material expressions of energy systems. In this sense, energy landscapes are constructed through the technical artifacts of energy production (e.g. power plant), energy distribution (e.g. power line), and energy consumption (e.g. electric mobility) ([23], p. 192). The range of material forms of expression would thus be the range of energy landscapes. Energy landscapes would then be composed of area-like, line-like, and point-like spaces, as it is common in the production of planning maps (raster, vector, and point data). A deeper insight into the socio-technical and socio-ecological relationships of energy landscapes, however, cannot be achieved in this way.

The spatial delimitation could therefore also be based on the representative, symbolic, discursive, and thus material-abstract phenomena of landscape. Without doubt, this seems to be much more complex, since the local contexts have to be taken into account and a generalisable orientation by material forms of land use becomes impossible. However, in order to understand the resistance against the Energiewende, this second approach seems appropriate, because the social perception of a landscape element and its territorial-institutional expression of power does not end with its technical-material boundary. The spatial delimitation of energy landscapes should therefore follow the discourses that emerge in the respective local context in relation to them.

Keeping with the concept of Lefebvre, there are even three possible points of reference for the delimitation of energy landscapes. In the context of ‘perceived space’, spatial practices (e.g. energy crop cultivation) would define the extent. If a farmer directs his practices on an agricultural land towards food and feed production in one year and energy production in the next, the boundary of the energy landscape would be a volatile one. However, if the discourses at this location evolve each year around the fundamental questions of whether the use of grain for energy production is justifiable and whether energy crop cultivation is not too strong a price driver for land, then the agricultural land would continually be part of a discursive energy landscape. In this sense, even an exclusion area for wind power plants would be part of an energy landscape if the area is part of a local discourse on the appropriate use of land. The delimitation of energy landscapes on the basis of ‘lived space’ must therefore take local discourses, values, and symbolism into account. Only then can perceived inequalities and injustices emanating from energy landscapes be understood.

In the sense of ‘conceived space’, the extent of energy landscapes would go hand in hand with the territorial-institutional claims to power of energy systems, which are asserted by laws and planning regulations. In addition to pre-burdened regions, which are the focus of the Energiewende, energy landscapes would then also include the landscapes protected by energy transition, which are free of technology. They would be the result of a powerful negotiation process around the exact demarcation line of technological intrusions in landscapes. The energy landscape would be composed of a legally legitimised technology-free and a technology-laden space. If the designation of protected areas is not related to the discourses on energy transition, then they would not be part of an energy landscape, but rather demarcated from it. This also applies to other land uses (agriculture and forestry, recreation, settlement, etc.).

5. Conclusion

Bruns & Kühne ([120], p. 88) stress that it is possible to reinterpret landscape developments and thus create the conditions for a changed perception. From a constructivist perspective, the physical objects of landscape represent a space of possibility in which social processes can re-inscribe themselves. Conflicts thus become essential elements of the energy transition and the expression of a vital democratic negotiation process [122]. Lefebvre's spatial concept offered a suitable approach to understanding the degree of democratic balance of social negotiation processes around German energy landscapes. In the concepts 'production of space', energy landscapes are no longer reduced to the technological artifacts of energy-related value chains, but are understood in their territorial-institutional construction and their discursive-representative character. Only in this way can the perceived and actual inequalities and injustices, which in Germany have now given rise to strong resistance, be understood and socially dealt with. With a view to achieving the climate goals, it therefore seems appropriate to understand the production of sustainable energy landscapes primarily as the production of a discourse about sustainability, equality, and justice. Based on this discourse, landscape changes become acceptable and in consequence possible for German society.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

[1] S. Strunz, The German energy transition as a regime shift, Ecol. Econ. 100 (2014) 150–158, https://doi.org/10.1016/j.ecolecon.2014.01.019.

[2] G. Kungl, Stewards or sticklers for change?Incumbent energy providers and the politics of the german energy transition, Energy Res. Social Sci. 8 (2015) 13–23, https://doi.org/10.1016/j.erss.2015.04.009.

[3] R. Quitzow, S. Roehrkasten, M. Jaenicke, The german energy transition in international perspective. https://www.iass-potsdam.de/sites/default/files/files/iass_ study_thegermanenergytransition_ininternationalperspective_en.pdf, 2016 (accessed 06 November 2019).

[4] Konrad-Adenauer-Stiftung (Ed.), Zwischenbilanz Energiewende. Ein internationaler Expertenblick. https://www.kas.de/c/document_library/get_file?uuid=3658c7d6-0589-c17c-b7ab-9b48ba3d9af5&groupId=252038, 2018 (accessed 12 October 2019).

[5] R. Kümmel, Energiewende, Klimaschutz, Schuldenbremse – Vorbild Deutschland? in: J. Ostheimer, M. Vogt (Eds.), Die Moral der Energiewende – Risikowahrnehmung im Wandel am Beispiel der Atomenergie, Kohlhammer, Stuttgart, 2014, pp. 109–133.

[6] M.A. Andor, M. Frondel, S. Sommer, Equity and the Willingness to Pay for Green Electricity in Germany, Nat. Energy 3 (10) (2018) 876–881 http://hdl.handle.net/ 10419/180620.

[7] K. Holm-Müller, M. Weber, P. Hennicke, T. Schleicher, C. Kemfert, A. Löschel, Ökonomische Folgen eines Atomausstiegs in Deutschland, Wirtschaftsdienst –, Zeitschrift für Wirtschaftspolitik 91 (5) (2011) 295–313, https://doi.org/10.1007/ s10273-011-1223-9.

[8] L. Prinz, A. Pegels, The role of labour power in sustainability transitions: Insights from comparative political economy on Germany's electricity transition, Energy Res. Social Sci. 41 (2018) 210–219, https://doi.org/10.1016/j.erss.2018.04.010.

[9] M.Y. Suberu, M.W. Mustafa, N. Bashir, Energy storage systems for renewable energy power sector integration and mitigation of intermittency, Renew. Sustain. Energy Rev. 35 (2014) 499–514, https://doi.org/10.1016/j.rser.2014.04.009.

[10] W. Fischer, J.-Fr. Hake, W. Kuckshinrichs, T. Schröder, S. Venghaus, German energy policy and the way to sustainability: Five controversial issues in the debate on the Energiewende, Energy 115 (3) (2016) 1580–1591, https://doi.org/10.1016/j. energy.2016.05.069.

[11] B.K. Sovacool, R.J. Heffron, D. McCauley, A. Goldthau, Energy decisions reframed as justice and ethical concerns, Nat. Energy 1 (2016), https://doi.org/10.1038/ nenergy.2016.24.

[12] D. Blackbourn, The conquest of nature. Water, landscape and the making of modern Germany, Pimlico, London, 2007.

[13] W. Brücher, Energiegeographie – Wechselwirkungen zwischen Ressourcen, Raum und Politik, Borntraeger, Berlin/Stuttgart, 2009.

[14] C. Chen, B. Xue, G. Cai, H. Thomas, S. Stückrad, Comparing the energy transitions in Germany and China: Synergies and recommendations, Energy Rep. 5 (2019) 1249–1260, https://doi.org/10.1016/j.egyr.2019.08.087.

[15] D.C. Sharma, Transforming rural lives through decentralized green power, Futures 39 (5) (2007) 583–596, https://doi.org/10.1016/j.futures.2006.10.008.

[16] R. Häußling, Techniksoziologie. Eine Einführung. 2., überarbeitete und aktualisierte Auflage, Verlag Barbara Budrich, Opladen/Toronto, 2019.

[17] R. Reibsch, Atomkraft – eine Partnerin der klimafreundlichen Erneuerbaren? Erneuerbare Energien. https://www.erneuerbareenergien.de/atomkraft-einepartnerin-der-klimafreundlichen-erneuerbaren, 2020 (accessed 14 May 2020).

[18] S. Bosch, Wohin mit dem Windrad? Die räumlichen Grenzen von Klimaschutz, Geographische Rundschau 72 (5) (2020) 34–39.

[19] W. Rammert, C. Schubert, Technische und menschliche Verkörperungen des Sozialen, Working Papers TUTS-WP-4-2017. https://www.ssoar.info/ssoar/bitstream/handle/document/56630/ssoar-2017-rammert_et_al-Technische_und_ menschliche_Verkorperungen_des.pdf?sequence=1&isAllowed=y&lnkname=ssoar-2017-rammert_et_al-Technische_und_menschliche_Verkorperungen_ des.pdf, 2017 (accessed 14 November 2019).

[20] M. Mai, Die Energiewende als Herausforderung der Zivilgesellschaft – gesamtgesellschaftlicher Konsens und partikulare Interessen, in: L. Holstenkamp, J. Radtke (Eds.), Handbuch Energiewende und Partizipation, Springer VS, Wiesbaden, 2018, pp. 227–239.

[21] S. Stremke, P. Picchi, Co-designing energy landscapes: application of participatory mapping and Geographic Information Systems in the exploration of low carbon futures, in: B.D. Solomon, K.E. Calvert (Eds.), Handbook on the Geographies of Energy, Edward Elgar, Cheltenham/Northhampton, 2017, pp. 368–379.

[22] M.J. Pasqualetti, S. Stremke, Energy landscapes in a crowded world: A first typology of origins and expressions, Energy Res. Social Sci. 36 (2018) 94–105.

[23] K. Calvert, K. Greer, M. Maddison-MacFadyen, Theorizing energy landscapes for energy transition management: Insights from a socioecological history of energy transition in Bermuda, Geoforum 102 (2019) 191–201.

[24] E. Jolivet, E. Heiskanen, 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 (2010) 6746–6754, https://doi.org/10. 1016/j.enpol.2010.06.044.

[25] H. Lefebvre, The production of space, Blackwell Publisher, Malden, 1991.

[26] A. Reckwitz, Grundelemente einer Theorie sozialer Praktiken. Eine sozialtheoretische Perspektive, Zeitschrift für Soziologie 32 (4) (2003) 282–301 http://www.zfs-online.org/index.php/zfs/article/viewFile/1137/674.

[27] S. Linke, Ästhetik der neuen Energielandschaften – oder: Was Schönheit ist, das weiß ich nicht“, in: O. Kühne, F. Weber (Eds.), Bausteine der Energiewende, Springer VS, Wiesbaden, 2018, pp. 409–430.

[28] U. Dolata, R. Werle (Eds.), Gesellschaft und die Macht der Technik – Soziökonomischer und institutioneller Wandel durch Technisierung, Schriften aus dem Max-Planck-Institut für Gesellschaftsforschung Köln 58, Campus Verlag, Frankfurt/New York, 2007.

[29] A. Nadaï, M.-J. Prados, Landscapes of energies, a perspective on the energy transition, in: M. Frovola, M.-.J. Prados (Eds.), Renewable Energies and European Landscapes. Lessons from Southern European Cases, Springer, Dordrecht, 2015, pp. 25–40.

[30] D. MacKenzie, L. Wajcman (Eds.), The social shaping of technology, Open University Press, Buckingham, 1999.

[31] W. Krauss, The ́ Dingpolitik ́ of wind energy in northern German landscapes: An ethnographic case study, Landscape Res. 35 (2) (2010) 195–208, https://doi.org/ 10.1080/01426390903557972.

[32] P. Berger, T. Luckmann, Die gesellschaftliche Konstruktion der Wirklichkeit – Eine Theorie der Wissenssoziologie, Fischer, Frankfurt a. Main, 1969.

[33] B. van Veelen, C. Haggett, Uncommon ground: the role of different place attachments in explaining community renewable energy projects, Sociologia Ruralis 57 (S1) (2016) 533–554, https://doi.org/10.1111/soru.12128.

[34] C. Fuchs, Henri Lefebvrés theory of the production of space and the critical theory of communication, Communication Theory 29 (2019) 129–150, https://doi.org/ 10.1093/ct/qty025.

[35] T. Greider, L. Garkovich, Landscapes: The social construction of nature and the environment, Rural Sociology 59 (1) (1994) 1–24, https://doi.org/10.1111/j. 1549-0831.1994.tb00519.x.

[36] R.I. McDonald, J. Fargione, J. Kiesecker, W.M. Miller, J. Powell, Energy sprawl or energy efficiency: climate policy impacts on natural habitat for the United States of America, PLoS ONE 4 (8) (2009), https://doi.org/10.1371/journal.pone. 0006802.

[37] J.M. Kiesecker, D.E. Naugle (Eds.), Energy sprawl solution, Island Press, Washington/Covelo/London, Balancing global development and conservation, 2017.

[38] A.M. Trainor, R.I. McDonald, J. Fargione, Energy sprawl is the largest driver of land use change in United States, PLoS ONE 11 (9) (2016), https://doi.org/10. 1371/journal.pone.0162269.

[39] L. Scazzosi, Reading and assessing the landscape as cultural and historical heritage, Landscape Res. 29 (4) (2004) 335–355.

[40] Council of Europe, European Landscape Convention. European Treaty Series No. 176. https://rm.coe.int/1680080621, 2000 (accessed 25 May 2020).

[41] M.J. Pasqualetti, Reading the changing energy landscape, in: S. Stremke, A. van den Dobbelsteen (Eds.), Sustainable energy landscapes – Designing, Planning, and development, CRC Press, Boca Raton/London/New York, 2013, pp. 11–44.

[42] D. Apostol, J. Palmer, M. Pasqualetti, R. Smardon, R. Sullivan (Eds.), The renewable energy landscape. Preserving scenic values in our sustainable future, Routledge, New York, 2017.

[43] Deutscher Rat für Landespflege (DRL) (Ed.), Die Auswirkungen erneuerbarer Energien auf Natur und Landschaft, Schriftenreihe des deutschen Rates für Landespflege 79, Meckenheim, 2006.

[44] F. Faller, Räumliche Praktiken der Energiewende am Beispiel der Biogaserzeugung in Rheinland-Pfalz, Raumforschung und Raumordnung 74 (3) (2016) 199–211, https://doi.org/10.1007/s13147-016-0413-8.

[45] S. Schöbel, Windenergie und Landschaftsästhetik – Zur landschaftsgerechten Anordnung von Windkraftanlagen, Jovis, Berlin, 2012.

[46] T. Höfer, Y. Sunak, H. Siddique, R. Madlener, Wind farm siting using a spatial Analytic Hierarchy Process approach: A case study of the Städteregion Aachen, Appl. Energy 163 (1) (2016) 222–243, https://doi.org/10.1016/j.apenergy.2015. 10.138.

[47] D. Sijmons, M. van Dorst, Strong feelings: Emotional landscape of wind turbines, in: S. Stremke, A. van den Dobbelsteen (Eds.), Sustainable energy landscapes – Designing, planning, and development, CRC Press, Boca Raton/London/New York, 2013, pp. 45–70.

[48] D. van der Horst, Energy landscapes of less than two degrees global warming, in: B.D. Solomon, K.E. Calvert (Eds.), Handbook on the Geographies of Energy, Edward Elgar, Cheltenham/Northhampton, 2017, pp. 251–264.

[49] O. Hohmeyer, R.L. Ottinger (Eds.), External environmental costs of electric power – Analysis and internalization, Springer, Heidelberg, 2012.

[50] Bundesamt für Strahlenschutz (Ed.), Epidemiologische Studie zu Kinderkrebs in der Umgebung von Kernkraftwerken. Mainz, 2007.

[51] R. Klæboe, H.B. Sundfør, Windmill noise annoyance, visual aesthetics, and attitudes towards renewable energy sources, Environ. Res. Public Health 13 (8)

[52] G. Bridge, S. Barr, S. Bouzarovski, M. Bradshaw, M. Brown, H. Bulkeley, G. Walker, Energy and society – A critical perspective, Routledge, New York, 2018.

[53] A. Månsson, A resource curse for renewables? Conflict and cooperation in the renewable energy sector, Energy Research & Social Science 10 (2015) 1–9, https://doi.org/10.1016/j.erss.2015.06.008.

[54] J. McCarthy, A socioecological fix to capitalist crisis and climate change? The possibilities and limits of renewable energy, Environment and Planning A 47 (2015) 2485–2502 https://doi.org/10.1177%2F0308518X15602491.

[55] E. Shove, Gaps, barriers and conceptual chasms: theories of technology transfer and energy in buildings, Energy Policy 26 (15) (1998) 1105–1112, https://doi.org/10.1016/S0301-4215(98)00065-2.

[56] H. Bulkeley, M. Watson, R. Hudson, P. Weaver, Governing municipal waste: towards a new analytical framework, J. Environ. Plann. Policy Manage. 7 (1) (2005) 1–24, https://doi.org/10.1080/15239080500251700.

[57] R. Cowell, Wind power, landscape and strategic, spatial planning – The construction of acceptable locations in Wales, Land Use Policy 27 (2010) 222–232, https://doi.org/10.1016/j.landusepol.2009.01.006.

[58] K.S. Zimmerer, The political and social ecologies of energy, in: B.D. Solomon, K.E. Calvert (Eds.), Handbook on the Geographies of Energy, Edward Elgar, Cheltenham/Northhampton, 2017, pp. 465–476.

[59] C. Harrison, E.J. Popke, Critical energy geographies, in: B.D. Solomon, K.E. Calvert (Eds.), Handbook on the geographies of energy, Edward Elgar, Cheltenham/ Northhampton, 2017, pp. 490–501.

[60] K. Bickerstaff, Geographies of energy justice: concepts, challenges and an emerging agenda, in: B.D. Solomon, K.E. Calvert (Eds.), Handbook on the Geographies of Energy, Edward Elgar, Cheltenham/Northhampton, 2017, pp. 438–449.

[61] R. Cowell, G. Bristow, M. Munday, Wind energy and justice for disadvantaged communities, Joseph Rowntree Foundation, York, 2012.

[62] K. Bradley, J. Hedrén, Utopian thought in the making of green futures, in: K. Bradley, J. Hedrén (Eds.), Green utopianism: Perspectives, politics and micropractices, Routledge, New York/Oxon, 2014, pp. 1–20.

[63] K. Yenneti, R. Day, O. Golubchikov, Spatial justice and the land politics of renewables: Dispossessing vulnerable communities through solar energy mega-projects, Geoforum 76 (2016) 90–99, https://doi.org/10.1016/j.geoforum.2016.09. 004.

[64] R. Phadke, Public deliberation and the geographies of wind justice, Sci. Culture 22 (2013) 247–255, https://doi.org/10.1080/09505431.2013.786997.

[65] R. Phadke, Resisting and reconciling big wind: Middle landscape politics in the New American West, Antipode 43 (3) (2011) 754–776, https://doi.org/10.1111/j. 1467-8330.2011.00881.x.

[66] N. Dusyk, Community energy: diverse, dynamic, political, in: B.D. Solomon, K.E. Calvert (Eds.), Handbook on the Geographies of Energy, Edward Elgar, Cheltenham/Northhampton, 2017, pp. 502–514.

[67] K. Gäbler, Heimaten der Nachhaltigkeit, in: E. Costadura, K. Ries, C. Wiesenfeldt (Eds.), Heimat global – Modelle, Praxen und Medien der Heimatkonstruktion, Edition Kulturwissenschaft 188, Transcript Verlag, Bielefeld, 2019, pp. 331–352.

[68] G. Walker, P. Devine-Wright, Community renewable energy: what should it mean? Energy Policy 36 (2008) 497–500, https://doi.org/10.1016/j.enpol.2007.10.019.

[69] M. Islar, H. Busch, We are not in this to save the polar bears! – the link between community renewable energy development and ecological citizenship, Innovation, Eur. J. Soc. Sci. Res. 29 (3) (2016) 303–319, https://doi.org/10.1080/13511610.2016.1188684.

[70] T. Haas, Energiearmut als neues Konfliktfeld in der Stromwende, in: K. Großmann (Ed.), Energie und soziale Ungleichheit, Springer Verlag, Wiesbaden, 2017, pp. 377–402.

[71] B. van Veelen, D. van der Horst, What is energy democracy? Connecting social science energy research and political theory, Energy Res. Soc. Sci. 46 (2018) 19–28, https://doi.org/10.1016/j.erss.2018.06.010.

[72] J. Radtke, G.S. Schaal, Die Energiewende in Deutschland. Versuch einer demokratietheoretischen Systematisierung, in: L. Holstenkamp, J. Radtke (Eds.), Handbuch Energiewende und Partizipation, Springer VS, Wiesbaden, 2018, pp. 143–155.

[73] G. Pellegrini-Masini, A. Pirni, S. Maran, Energy justice revisited: A critical review on the philosophical and political origins of equality, Energy Res. Social Sci. 59 (2020), https://doi.org/10.1016/j.erss.2019.101310.

[74] J.A. McGee, P.T. Greiner, Renewable energy justice: The socio-environmental implications of renewable energy consumption, Energy Res. Social Sci. 56 (2019), https://doi.org/10.1016/j.erss.2019.05.024.

[75] M.J. Burke, J.C. Stephens, Political power and renewable energy futures: A critical review, Energy Res. Social Sci. 35 (2018) 78–93, https://doi.org/10.1016/j.erss. 2017.10.018.

[76] S. Bouzarovski, N. Simcock, Spatializing energy justice, Energy Policy 107 (2017) 640–648, https://doi.org/10.1016/j.enpol.2017.03.064.

[77] L. Schwarz, Empowered but powerless? Reassessing the citizeńs power dynamics of the German energy transition, Energy Res. Social Sci. 63 (2020), https://doi. org/10.1016/j.erss.2019.101405.

[78] S. Bosch, J. Rathmann, Deployment of Renewable Energies in Germany: Spatial Principles and their Practical Implications Based on a GIS-Tool, Adv. Geosci. 45 (2018) 115–123, https://doi.org/10.5194/adgeo-45-115-2018.

[79] S. Bosch, J. Rathmann, L. Schwarz, The Energy Transition between profitability, participation and acceptance – considering the interests of project developers, residents, and environmentalists, Adv. Geosci. 49 (2019) 19–29, https://doi.org/ 10.5194/adgeo-49-19-2019.

[80] H. Job, M. Woltering, B. Warner, S. Heiland, E. Jedicke, P. Meyer, B. Nienaber, T. Plieninger, M. Pütz, S. Rannow, E. Ruschkowski, Biodiversität und nachhaltige Landnutzung in Großschutzgebieten, Raumforschung und Raumordnung 74 (6) (2016) 481–494.

[81] B. Zaspel-Heisters, Welcher Raum bleibt für den Ausbau der Windenergie? Analyse des bundesweiten Flächenpotenzials in Deutschland, in: BBSR (Ed.), Informationen zur Raumentwicklung 6, Bonn, 2015, pp. 543–569.

[82] B. Laggner, N. Orthen, B. Osterburg, N. Röder, Ist die zunehmende Biogasproduktion die alleinige Ursache für den Grünlandschwund in Deutschland? – eine Analyse von georeferenzierten Daten zur Landnutzung, Raumforschung und Raumordnung 72 (3) (2014) 195–209, https://doi.org/10.1007/s13147-0140278-7.

[83] T. Blaschke, M. Biberacher, S. Gadocha, I. Schardinger, Energy landscapes: Meeting energy demands and human aspirations, Biomass Bioenergy 55 (2013) 3–16, https://doi.org/10.1016/j.biombioe.2012.11.022.

[84] B. Nölting, M. Thomas, R. Land, Energie im Osten. Die Energiewende als Chance für einen zukunftsfähigen Entwicklungspfad für Ostdeutschland, in: D. Keppler, B. Nölting, C. Schröder (Eds.), Neue Energie im Osten – Gestaltung des Umbruchs. Perspektiven für eine zukunftsfähige sozial-ökologische Energiewende. Peter Lang, Bern, 2011, pp. 15–35.

[85] S. Becker, L. Gailing, M. Naumann, Neue Energielandschaften – Neue Akteurslandschaften. Eine Bestandsaufnahme in Brandenburg. Rosa-LuxemburgStiftung, Berlin, 2012.

[86] M. Deshaies, The new post-mining energy landscapes in the lignite basin of Lower Lusatia (Germany). Europa Regional 25.2017 (3–4) (2018) 29–41. https://nbnresolving.org/urn:nbn:de:0168-ssoar-62253-4.

[87] D. Demeritt, Scientific forest conservation and the statistical picturing of nature's limits in the progressive-era United States, Society and Space 19 (2001) 431–459 10.1068%2Fd294.

[88] D. Harvey, The new imperialism, Oxford University Press, New York, 2003.

[89] F. Dittgen, Naturschutzgebiet als Windkraft-Stopp? https://www.saarbrueckerzeitung.de/saarland/saarbruecken/heusweiler/naturschutzgebiet-als-windkraftstopp_aid-1703520, 2016 (accessed 14 February 2018).

[90] D. Tatu Tourismus und Windenergie – Einfluss des Tourismus auf den Ausbau der Windenergie am Beispiel der Regionalplanung in Bayern. https://opus.bibliothek. uni-augsburg.de/opus4/frontdoor/deliver/index/docId/50416/file/Tatu_Diss. pdf, 2019 (accessed 23 May 2020).

[91] C. Fraune, M. Knodt, Sustainable energy transformations in an age of populism, post-thruth politics, and local resistance, Energy Res. Social Sci. 43 (2018) 1–7, https://doi.org/10.1016/j.erss.2018.05.029.

[92] T.L. Baker, Irrigating with windmills on the Great Plains, Great Plains Quaterly 385 (1989) 216–230 https://digitalcommons.unl.edu/cgi/viewcontent.cgi? referer=https://www.google.com/&httpsredir=1&article=1384&context= greatplainsquarterly.

[93] E. Swyngedouw, Liquid power – Contested hydro-modernities in twentieth-century spain, MIT Press, Cambridge, 2015.

[94] B.D. Solomon, K. Krishna, The coming sustainable energy transition: History, strategies, and outlook, Energy Policy 39 (11) (2011) 7422–7431, https://doi.org/ 10.1016/j.enpol.2011.09.009.

[95] S. Schweiger, J.-H. Kamlage, S. Engler, Ästhetik und Akzeptanz. Welche Geschichten könnten Energielandschaften erzählen? in: O. Kühne, F. Weber (Eds.), Bausteine der Energiewende, Springer VS, Wiesbaden, 2018, pp. 431–446.

[96] P. Devine-Wright, Rethinking NIMBYism: the role of place attachment and place identity in explaining place protective action, J. Commun. Appl. Soc. Psychol. 19 (2009) 426–441, https://doi.org/10.1002/casp.1004.

[97] P. Devine-Wright, Y. Howes, Disruption to place attachment and the protection of restorative environments: A wind energy case study, J. Environ. Psychol. 30 (3) (2010) 271–280, https://doi.org/10.1016/j.jenvp.2010.01.008.

[98] P. Devine-Wright, Place attachment and public acceptance of renewable energy: A tidal energy case study, J. Environ. Psychol. 31 (4) (2011) 336–343, https://doi. org/10.1016/j.jenvp.2011.07.001.

[99] J. Osterhammel, Die Verwandlung der Welt. Eine Geschichte des 19. Jahrhunderts. Beck, München, 2011.

[100] J. Koehrsen, Does religion promote environmental sustainability? – Exploring the role of religion in local energy transitions, Social Compass 62 (3) (2015) 296–310 10.1177%2F0037768615587808.

[101] G. Bettini, L. Karaliotas, Exploring the limits of peak oil: naturalising the political, de-politicising energy, Geograph. J. 179 (4) (2013) 331–341, https://doi.org/10. 1111/geoj.12024.

[102] D.H. Meadows, D.L. Meadows, J. Randers, W.W. Behrens, The limits to growth – A report for the club of romés project on the predicament of mankind, Universe Books, New York, 1972.

[103] A. Nadaï, D. van der Horst, Introduction: Landscapes of Energies, Landscape Res. 35 (2) (2010) 143–155, https://doi.org/10.1080/01426390903557543.

[104] M. Leibenath, Landschaft im Diskurs: Welche Landschaft? Welcher Diskurs? Praktische Implikationen eines alternativen Entwurfs konstruktivistischer Landschaftsforschung, Naturschutz und Landschaftsplanung 46 (4) (2014) 124–129 https://www2.ioer.de/recherche/pdf/2014_leibenath_landschaft-imdiskurs.pdf.

[105] O. Kühne, Heimat und sozial nachhaltige Landschaftsentwicklung, Raumforschung und Raumordnung 69 (5) (2011) 291–301 https://link.springer.com/article/10. 1007/s13147-011-0108-0.

[106] N. Cass, G. Walker, Emotion and rationality: The characterization and evaluation of opposition to renewable energy projects, Emotion, Space Soc. 2 (1) (2009) 62–69, https://doi.org/10.1016/j.emospa.2009.05.006.

[107] J. Solli, Where the eagles dare? Enacting resistance to wind farms through hybrid collectives, Environmental Politics 19 (1) (2010) 45–60, https://doi.org/10.1080/ 09644010903396077.

[108] K. Berr, Ethische Aspekte der Energiewende, in: O. Kühne, F. Weber (Eds.), Bausteine der Energiewende, Springer VS, Wiesbaden, 2018, pp. 57–74.

[109] M.J. Pasqualetti, B.D. Solomon, Geographical dimensions of wind power, in: B.D. Solomon, K.E. Calvert (Eds.), Handbook on the Geographies of Energy, Edward Elgar, Cheltenham/Northhampton, 2017, pp. 134–147.

[110] E. Aschenbrand, C. Grebe, Erneuerbare Energie und intakte Landschaft: Wie Naturtourismus und Energiewende zusammenpassen, in: O. Kühne, F. Weber (Eds.), Bausteine der Energiewende, Springer VS, Wiesbaden, 2018, pp. 523–538.

[111] D. Sijmons, Landscape and Energy: Designing Transition, nai010 Publishers, Rotterdam (2014).

[112] H.-W. Wehling, Das UNESCO-Welterbe und das Ruhrgebiet, in: Essener Gesellschaft für Geographie und Geologie (Ed.), Mitteilungen der Essener Gesellschaft für Geographie und Geologie 2, 2016, pp. 24–34.

[113] M. Vogt, Die Moral der Energiewende – Eine Topographie ethischer Herausforderungen, in: M. Heimbach-Steins (Ed.), Jahrbuch für Christliche Sozialwissenschaften, Ethische Herausforderungen der Energiewende 56, Aschendorff Verlag, Münster, 2015, pp. 85–106.

[114] K. Jenkins, B.K. Sovacool, D. McCauley, Humanizing sociotechnical transitions through energy justice: An ethical framework for global transformative change, Energy Policy 117 (2018) 66–74, https://doi.org/10.1016/j.enpol.2018.02.036

[115] B.K. Sovacool, Energy & ethics – Justice and the global energy challenge, Palgrave Macmillan, Basingstoke, 2013.

[116] R. Inglesi-Lotz, The impact of renewable energy consumption to economic growth: A panel data application, Energy Econ. 53 (2016) 58–63, https://doi.org/10.

[117] R. Hastik, S. Basso, C. Geitner, C. Haida, A. Poljanec, A. Portaccio, B. Vrščaj,C. Walzer, Renewable energies and ecosystem service impacts, Renew. Sustain. Energy Rev. 48 (2015) 608–623, https://doi.org/10.1016/j.rser.2015.04.004.

[118] F.C. Paul, Deep entanglements: History, space and (energy) struggle in the German Energiewende, Geoforum 91 (2018) 1–9.

[119] P. Devine-Wright, From backyards to places: public engagement and the emplacement of renewable energy technologies, in: P. Devine-Wright (Ed.), Renewable energy and the public: From NIMBY to participation, Earthscan, London, 2010, pp. 57–70.

[120] D. Bruns, O. Kühne, Landschaft im Diskurs – Konstruktivistische Landschaftstheorie als Perspektive für künftigen Umgang mit Landschaft, Naturschutz Landschaftsplan. 45 (3) (2013) 83–88 https://www.nul-online.de/ artikel.dll/NuL03-13-Inhalt-83-88-1_Mzc4NDEyOA.PDF.

[121] D. Ohlhorst, Germanýs energy transition policy between national targets and decentraliced responsibilities, J. Integr. Environ. Sci. 12 (4) (2015) 303–322, https://doi.org/10.1080/1943815X.2015.1125373.

[122] E. Cuppen, The value of social conflicts. Critiquing invited participation in energy projects, Energy Res. Soc. Sci. 38 (2018) 28–32, https://doi.org/10.1016/j.erss. 2018.01.016.

[123] S. Bosch, L. Schwarz, The energy transition from plant operators' perspective – a behaviorist approach, Sustainability 11 (6) (2019) 1621, https://doi.org/10. 3390/su11061621.