To support or oppose renewable energy projects? A systematic literature review on the factors influencing landscape design and social acceptance

Article *in* Energy Research & Social Science · September 2022
DOI: 10.1016/j.erss.2022.102740

Merel Enserink
Wageningen University & Research

Sven Stremke
Wageningen University & Research

Energy Research & Social Science 91 (2022) 102740

Contents lists available at ScienceDirect

Energy Research & Social Science

journal homepage: www.elsevier.com/locate/erss

To support or oppose renewable energy projects? A systematic literature review on the factors influencing landscape design and social acceptance

Merel Enserink *, Rudi Van Etteger, Adri Van den Brink [1], Sven Stremke

Wageningen University & Research, Environmental Sciences Group, Landscape Architecture Chair Group, Droevendaalsesteeg 3, 6708 PB Wageningen, the Netherlands

A R T I C L E I N F O

Keywords:
Energy transition
Local acceptance
Inclusive design processes
Energy planning
Energy landscape

A B S T R A C T

The local implementation of renewable energy projects often faces opposition. The landscape transformation that comes with the transition to renewables is one of the key counter-arguments of local stakeholders. In this article, we examine the relation between research on 'designing landscape transformations' and 'acceptance of renewable energy projects'; whether and how these bodies of knowledge may complement each other. The systematic literature review revealed that acceptance studies and landscape design studies describe 25 similar factors that influence acceptance. The majority of these factors are somewhat general in nature, such as *economic benefits*, *visual impact*, and *aesthetics*. Additionally, we found 45 unique factors in acceptance studies and sixteen unique factors in landscape design studies. Furthermore, we found differences in distribution of factors when categorizing and comparing them by means of two conceptual frameworks. Moreover, the emphasis in peer-reviewed literature differs significantly from laypersons, which is challenging the current research agenda on landscape transformation and acceptance of renewable energy. The findings and the knowledge lacunas provide clear avenues for a shared research agenda. Future research needs to examine the influence of involving landscape designers on the acceptance of renewable energy projects and the effects of more inclusive design processes on factors such as *trust*.

1. Introduction

The transition to renewable energy, following from (inter-) national policies and agreements (e.g. the Paris Climate Agreement), leads to landscape transformations [1,2]. These transformations involve a change in the dominant land use and of the visual appearance of the landscape. Consequently, new types of energy landscapes are being developed that employ different types of renewable energy sources [3,4].

The local implementation of renewable energy projects often lacks public support [5–8]. Many scholars affirm that public support is a key for a successful and timely transition to renewable energy [5,7,9–12]. Public acceptance is defined in this study as the passive or active response of local stakeholders in a positive or negative manner towards landscape transformations [9]. It is an indicator for the level of local support or opposition towards a particular renewable energy project.

A substantial body of scholarly work exists on the acceptance of renewable energy projects (e.g. [9,13–15]). The outcomes of these studies vary, but several factors for success or failure of local implementation of renewable energy projects are recurring in the literature (e.g. economic benefits, environmental impact, process, and procedural justice). Several of these studies consider 'landscape' or related terms (e.g. landscape values, visual impact, landscape perception, landscape characteristics, landscape modification) as factors that influence support or opposition to renewable energy projects [15–19]. Bertsch et al. [20] consider transformation of the landscape as the main driving factor for the local acceptance of renewable energy projects.

More and more landscape architects contribute to the implementation of renewable energy projects. They act for example as 'facilitator' or 'boundary spanner' between policy and practice, and consult in specific renewable energy projects [21–24]. The involvement of landscape architects may relate to both the process of producing the design and the actual content of measures taken in the landscape design. Whereas the influence of landscape and landscape change on the acceptance of renewable energy projects is confirmed by several scholars (e.g. [19,20]), the role of design in this landscape transformation receives little attention [6]. This is remarkable, because in many countries, such as the UK, The Netherlands, and Germany, landscape transformations

* Corresponding author at: Postbus 47, 6700 AA Wageningen, the Netherlands.
E-mail address: merel.enserink@wur.nl (M. Enserink).

[1] Passed away

https://doi.org/10.1016/j.erss.2022.102740
Received 22 November 2021; Received in revised form 2 July 2022; Accepted 6 July 2022
Available online 1 August 2022

are the outcome of a deliberate process in which various considerations are discussed and recorded in drawings, not least the consequences of renewable energy technology for the landscape and the necessary change of the landscape for its realization.

To address this knowledge gap we explore the relation between landscape design and acceptance of renewable energy projects. The study presents a novel theoretical synthesis [25] between the fields of 'acceptance studies on renewable energy' and 'landscape design studies'. We study how these fields currently acknowledge each other, what overlaps exist between the fields in terminology and considered topics, and where the fields could strengthen each other in the future. For this, we performed a systematic literature review, to analyse both fields on the factors they describe to influence local acceptance of renewable energy projects. We compare the fields to reflect on differences and similarities in terms of factors. Furthermore, the study has empirical novelty while it contributes to a better understanding of acceptance of renewable energy in these two domains. Additionally, the study provides an opportunity to relate our findings to the daily practice of policy-makers, practitioners and other stakeholders in both fields.

In the next section we introduce 'landscape design' and 'acceptance' in connection to renewable energy and conceptualize how these fields are interrelated. The third section describes our methods and materials. Section four elaborates on the factors that influence the opposition and support for renewable energy projects from the fields of 'acceptance' and 'landscape design'. In section five, we discuss the results and present our main conclusions.

2. Conceptual framework

Our literature review is based upon a thorough understanding of two key concepts and their interrelation. Firstly, we describe the concept of 'landscape design' and its connection with acceptance of renewable energy projects. Secondly, we describe the concept of 'acceptance' of renewable energy and its connection with landscape design.

2.1. Landscape design and renewable energy

The term landscape varies in status, meaning and usage [26,27]. Landscape can be referred to as (a) an indication of a place or terrain (e.g. [27]), (b) the visual perception, scenic value or experience of a place (e.g. [19]), or (c) both the physical characteristics and the perception of a landscape. The latter interpretation is in line with Article 1 of the European Landscape Convention (ELC) [28], which describes landscape as "an area as perceived by people, whose character is the result of the action and interaction of natural and/or human factors". In the research presented in this paper, we embrace this comprehensive definition of ELC because it includes both the experience of a current situation as well as the possibility of changing this situation either by natural development or human intervention. Perception of landscape change is considered by several landscape design studies as a factor that influences local acceptance (e.g. [29–31]).

Scognamiglio [32] draws a direct connection between local acceptance of renewable energy projects and designing solar energy landscapes. She argues that the importance of landscape design for local support is highly underestimated. Landscape architects design landscapes to accommodate (new) uses while taking into account the functional, experiential and temporal dimensions of landscapes [33]. In a recent study, Oudes & Stremke [33] studied three cases of large-scale landscape transformation, and concluded that designing large-scale transformations can benefit from a more encompassing approach and attention to these three dimensions of landscape. Moreover, Sijmons & Van Dorst [34] stress that the role of landscape design is threefold. Firstly that landscape designers should make good designs at every relevant scale, secondly that design might also play a role in the process in terms of mediation, by giving spatial expression to the existing socio-cultural values in the landscape transformation. Finally, design in their opinion can provide a consistent connective narrative for the landscape transformation which can play a role in communication between policymakers and the public.

Stremke [4] introduced a conceptual framework for the design and designing of sustainable energy landscapes that comprises sustainable technical, economic, environmental, and social aspects. How these aspects are addressed in the design and the design process itself determine whether a renewable energy landscape can be considered sustainable or not. While current renewable energy developments mainly focus on the technical and economic dimensions, Stremke [4] addresses the importance of considering all four dimensions in an integral manner. Moreover, by emphasizing the involvement of local stakeholders in the landscape design processes, he draws attention to the critical importance of local acceptance. The sustainable energy landscape framework [4] is used as a basis in several landscape design studies on renewable energy landscapes (e.g. [23,35]).

2.2. Acceptance of renewable energy

In the literature on 'acceptance of renewable energy' the definition of the term 'acceptance' is discussed extensively. Some scholars define acceptance as a static, positive judgement or aim. Cohen et al. [36] for example, state that social acceptance is a balance that can be attained by considering positive outcomes, such as economic benefits and greenhouse gas reduction, as a counterweight to overcome negative outcomes, such as diminished view sheds and landscape intrusion. Other scholars understand acceptance as an indication of the passive or active support and opposition (e.g. [9,37]) that changes over time (e.g. [16,38]) and varies according to different geographical scales (e.g. [39]). Bertsch et al. [20] align with this interpretation and define acceptance as "a subjective measure of the readiness of people to accept a certain facility in their neighbourhood – regardless of rational judgement". In this research we follow this more dynamic interpretation of acceptance, it being both the local support and opposition towards a landscape change [9,37], which can differ on geographical scales [39], that can be influenced [6], and can change over time [16,38].

Acceptance studies on renewable energy differ in the factors they consider important for acceptance. The most general approach for studying acceptance is to simply differentiate between two groups of factors: those of support and those of opposition to renewable energy projects [37]. However, many studies distinguish more specific factors for defining and measuring acceptance of renewable energy projects. Perlaviciute & Steg [14] studied contextual and psychological factors for determining 'public acceptability' of renewable energy, taking into account both collective and individual level costs and benefits as well as perceived fairness. Devine-Wright [41] presents a framework of project-related factors that influence local acceptance of renewable energy projects, namely place attachment, impact, trust, and procedural justice. Gölz & Wedderhoff [9] examined the perception of fairness, trust, and regional added value to measure the 'regional acceptance' of the German energy transition. Another scholarly discussion focuses on the different layers of social acceptance. Sovacool & Ratan [42] advanced the framework by Wüstenhagen et al. [8] adding several conditions to the three layers that together shape 'social acceptance' of renewable energy: socio-political, market, and community acceptance. Recently, Roddis et al. [15] specifically examined 'community acceptance' arguing this to be the most important level for implementation and support of renewable energy projects, especially when considering the deployment stage. Their research, a literature study and case study on a solar power plant, reveals a large number of determinants which they cluster into eight main factors: aesthetic, environmental, economic, project details, temporal, social, construction and process (Fig. 1). The strength of their study is that they test their framework, which is based on peer-reviewed literature, in a case study. This enables them to distinguish which factors are found most important by laypersons and how this relates to the emphasis of such factors in peer-reviewed

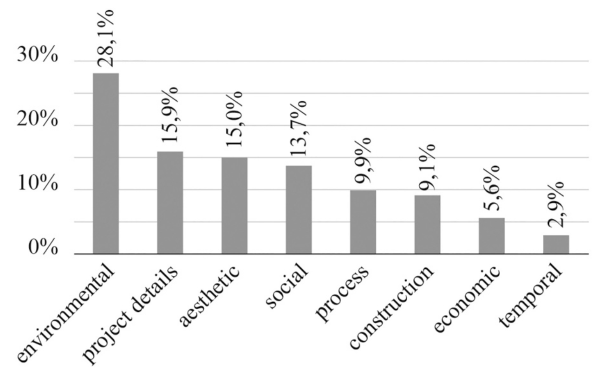

Fig. 1. Percentages of factors (i.e. determinants of community acceptance), from the public on a case study of a solar power plant [15].

literature. Interestingly, the factor environmental scored highest (28,1 %) in their case study, while temporal and economic factors are least considered by the community in this case study.

Landscape is often mentioned in acceptance studies on renewable energy. Landscape, however, is seldom defined and - if so - definitions vary greatly. Some scholars refer to landscape as the place where a transformation is happening which can be impacted negatively. However, they do not always provide a definition of what they consider landscape to be (e.g. [43]). Some authors refer to the ELC or similar definitions, acknowledging the interplay of human and natural influences and the temporal dimension of landscape (e.g. [44,45]). Several acceptance studies refer to the human perception of landscape and, more specifically, the visual impact caused by a renewable energy project often relating to existing landscape values [6,16,46,63]. Bevk & Golobič [6] stress that landscape design should receive more attention when solar power plants are developed. Devine-Wright [47] argues that a better understanding is urgently needed of how processes of engagement in renewable energy siting are influencing public perceptions.

Although the acceptance of renewable energy projects is related to the landscape and the design of those landscapes, and landscape design includes social factors, no papers explore the terminological and thus theoretical links between the two fields. In this study we are looking for the theoretical meeting points between the fields of landscape design and acceptance of renewable energy projects, by identifying factors that influence acceptance. We hypothesize that social science may have a blind spot for what interactive and creative opportunities landscape design can offer and that landscape architects may have a blind spot for some of the social factors that are known to be of influence for the acceptance of landscape transformations. In the following section we describe the methods we employed in our research.

3. Methods

This paper is based on a systematic literature review [48–50,52], employed to identify factors for the support or opposition to renewable energy projects from two distinct bodies of literature, namely the field of 'acceptance studies' and the field of 'landscape design' involved with large-scale landscape transformations such as renewable energy landscapes. To ensure transparent and reproducible results, we hereafter describe the following three research steps [50]: (1) search strategy development & implementation; (2) relevance & quality assessment; and (3) data extraction & synthesis.

3.1. Search strategy development & implementation

We performed two separate searches in the online database *Web of Science*. We used this database because it is considered to be the most sophisticated scientific search engine within The Netherlands, our university, and research domain. Moreover, Web of Science only includes journals with a high impact factor, which we see as a validation of a thorough scientific screening through academic peer-review. Each search focused on one field: acceptance studies and landscape design studies. We defined keywords based on the scope of the research objective. For the acceptance studies we were interested in a broad list of factors that influence support or opposition towards renewable energy projects, therefore we employed the keywords: "acceptance" AND "renewable energy" AND "landscape". The reference to landscape in title, keywords or abstract limited the amount of papers that we retrieved. For the literature search on landscape design studies we defined the keywords: "landscape architecture" OR "landscape design" OR "landscape planning" AND "renewable energy". We limited the literature searches to original research articles. To further refine the search results we limited our searches to consider the subject areas 'environmental science', 'social science', or 'energy'. We did not apply a filter on year of publication in either of the searches.

In the field of acceptance studies, we identified 83 records. We then added nine relevant publications that were suggested to us by other scholars or mentioned in the initial 83 records. The total sample on acceptance of renewable energy included 92 records. In the field of landscape design, we identified 40 records. Because the literature search did not retrieve all records known by the authors we used a snow-ball technique to find additional relevant literature [51] and supplemented the sample with peer-reviewed literature known by the authors or suggested to us by other scholars. One explanation for these missing records is that landscape design papers do not always mention the discipline in title, abstract or keywords. Another explanation for the limited amount of records is that the landscape design studies are limited to the field of landscape architecture, −design, and spatial planning; Whereas the acceptance papers draw from multiple fields, such as engineering, psychology, geography and political science. Together, we identified nine additional records, which resulted in a total sample of 49 records in the field of landscape design. We identified a total of 141 records in both fields (Fig. 2).

3.2. Relevance & quality assessment

In the second step of the review process we performed a critical relevance and quality assessment by screening the retrieved publications to decide which ones to examine in detail [48,50]. First, the first author examined the usage of our search terms in the title, keywords and abstract to ensure the relevance of the publications for this literature review. The abstracts were examined in more detail to ensure the suitability of the records to answer our research questions. A very large share of the landscape design studies did not make any reference in the abstract to possible influences for support or opposition of landscape transformation, making them irrelevant for this study. Those were therefore excluded from the sample. The outcomes of this assessment were reviewed by the other authors. Additionally, if the relevance of the study was doubted by the first author the record was discussed by all authors, after which they decided to include or exclude the record for quality assessment. After this first check we included 70 records from acceptance studies and 15 records from landscape design studies for the quality assessment. We used the following inclusion criteria: For acceptance studies the main criterion for selection was the reference to landscape or environmental factors relating to acceptance. For landscape design studies we established the following criteria 1) the study should focus on the contextual setting or design of larger landscape transformations, preferably related to renewable energy; and 2) the study then should refer to acceptance or social factors that are considered. All case studies were evaluated on reliability and scale. After the quality assessment, the final sample included a total of 71 papers: 58 publications on acceptance and 13 publications on landscape design. The records in the acceptance field were published between 2007 and 2021; the records from the landscape design field between 2010 and 2021. The geographical distribution of papers differed between both

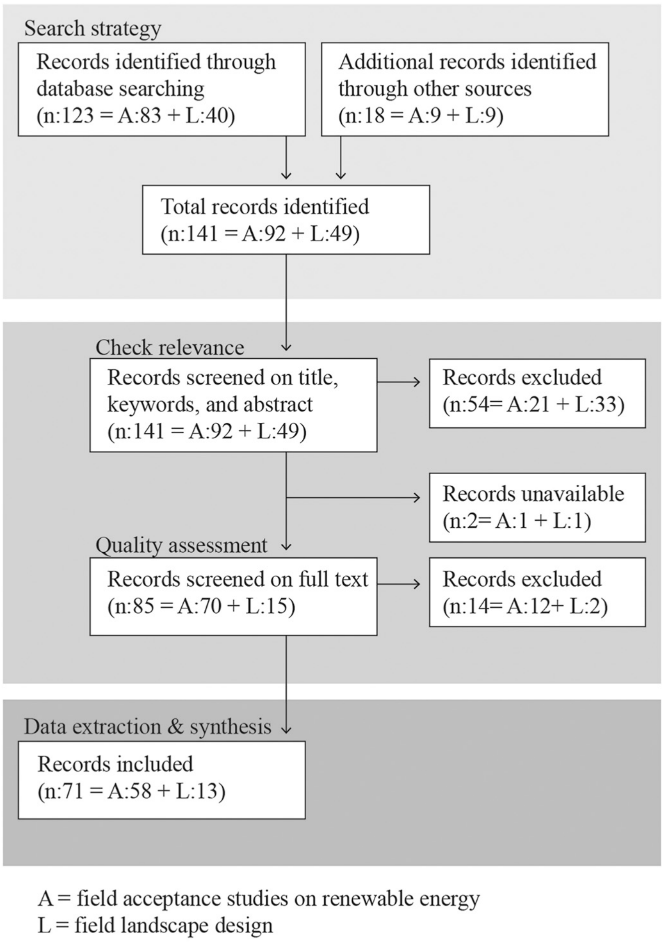

Fig. 2. Process overview literature search, relevance & quality assessment, and data extraction & synthesis.

fields, the landscape design papers were mostly related to the European context, while the acceptance field addressed a wider context. Besides many European studies, the sample included several studies from Australia, Canada, Japan, and the USA. We excluded none of renewable energy technologies in our sample.

3.3. Data extraction & synthesis

The last step in the review process was to compare the content of the papers that were selected through data extraction and synthesis. We extracted data on references to factors for acceptance (or similar) from both fields. The indication of factors differs per article, some state clearly which factors they address in relation to acceptance, others only acknowledge that a certain influence played a part in effecting support or opposition. All data were recorded in a Microsoft Excel spreadsheet, as a tool for identifying patterns across studies [53]. Many studies defined their own factors or made adjustments to existing frameworks by adding additional factors or specifying factors. This led to an overview of factors, which we used to identify similarities and differences between both fields by comparing the data in two steps (Fig. 3). First, we compared both fields on their factors to identify similarities and differences in terms and in number of references to each factor. Secondly, we examined the similarities and differences between the fields in the emphasis placed on factors in acceptance studies and landscape design studies. We did this by categorizing the factors from both fields according to two existing conceptual frameworks. First according to the sustainable energy landscape framework [4], to examine how the factors relate to a theory from landscape design. And, secondly, categorizing the

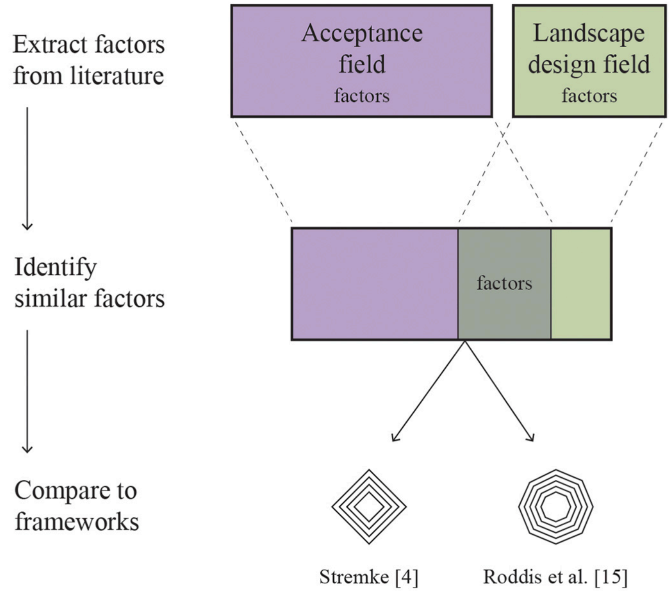

Fig. 3. Overview of steps performed during data extraction & synthesis.

factors according to the community acceptance framework by Roddis et al. [15], to perform a similar comparison with a framework from acceptance studies. In the comparison, we worked with percentages to deal with the large difference in found records between the fields. This enabled us to compare the relative frequency of occurrence of factors in peer-reviewed literature within and between the two research fields. This frequency does not represent any weight or importance of a certain factor.

4. Results

4.1. Overview of factors

The analysis of papers from both fields results in a set of 86 factors that influence support or opposition towards renewable energy projects. We extract 70 factors from acceptance studies and 41 factors from landscape design studies. By comparing the 86 factors from both fields we identify a number of similarities and related factors. All factors are sorted per field according to the frequency of appearance in the literature (Table 1).

4.1.1. Factors mentioned in acceptance studies

Overall the acceptance studies on renewable energy range from considering a few general factors (e.g. [9,54]) all the way to 28 specific determinants [15]. Most acceptance studies on renewable energy select which factors are necessary to be examined to answer their research question. This often leads to a selection of factors or specifications of factors. An example is the factor *trust*, which is referred to by some scholars in general as *trust* (e.g. [14,38,55]) and by others defined more specifically as *trust in the developer* (e.g. [41,45,46]), or as *trust in politics & institutions* (e.g. [16,56]). The most frequently mentioned factor in the field of acceptance studies is *economic benefits*. *Environmental impact* and *visual impact* are often mentioned in acceptance studies as factors to influence support or resistance towards renewable energy projects.

4.1.2. Factors mentioned in landscape design studies

Examining acceptance of renewable energy landscapes is, as we found in this literature review, seldom the aim of the landscape design studies. Therefore the number of peer-reviewed landscape design studies addressing the relation between landscape and acceptance is limited. Nevertheless, we found thirteen studies that refer to acceptance and

Table 1
The 70 factors from acceptance studies and 41 factors from landscape design studies, sorted on four levels according to the frequency of appearance in peer-reviewed literature. Factors with the same term in both fields are shown in italic.

Frequency of appearance	Factors mentioned in the acceptance field (n: 70/86)	Factors mentioned in the landscape design field (n: 41/86)
Very often (> 60 %)		*Community involvement & participation*;
often (40–60 %)	*Economic benefits*; *environmental impact*; *visual impact*;	*Aesthetics & scenic quality*; *community values*; *environmental concerns*; *perception of landscape change*;
Sometimes (20–40 %)	*Aesthetics & scenic quality*; nuisance; *community involvement &participation*; *community values*; *decision making*; *landscape values*; *procedural justice*; *economic impact*; *perception of landscape change*; *place attachment*; *communication*; *environmental concerns*; *jobs*; Health & well-being; process; site selection; temporal dimension; transparency; moral & ethical values; design; landscape characteristics; trust; visibility;	*Economic benefits*; *visual impact*; *environmental impact*; *landscape quality*; *place attachment*; *attitudes (towards RE)*; *economic impact*; *jobs*; *nuisance*; *project size*; *recreation and community activities;* Designing renewable energy landscapes; close collaboration with local authorities; involving farmers; landscape architect as facilitator; multifunctional land-use;
Seldom (< 20 %)	*Attitudes (towards RE)*; *landscape quality*; *wildlife habitats & -creation*; *CO2 emissions*; *knowledge & understanding of RET*; *price*; *perception of risk*; *project size*; *recreation & community activities*; Cultural heritage; demographic characteristics; fairness; information; regional added value; technology; trust in developer; impact on agricultural land use; (cost) efficient; geographical locations; property values; social values; safety of plant; tourism; air pollution; construction; end-of-life; landscape modification; noise pollution; physical characteristics of energy alternatives; project details; trust in politics & institutions; alternative options; business model; cumulative impacts; flooding; functional efficiency; legacy; light pollution; mitigation measures; NIMBY; quality of energy provision; stable energy provision; traffic; visual preference.	*Knowledge & understanding of RET*; *communication*; *CO2 emissions*; *decision making*; *landscape values*; *perception of risks*; *price*; *procedural justice*; *wildlife habitats & -creation;* Ecological compensation; ecosystem services; environmental (in)justice; inclusive bottom-up processes; economic sustainability; energy security; forced expansion; key role of cultural and public associations; landscape narrative; local initiative & energy cooperation; multi-stakeholder process.

describe several factors that influence acceptance (e.g. [23,30,57]). On average, studies from the field of landscape design refer to nine factors. Similar to the acceptance studies, the factors differ both in scale and definition. Moreover, some of the factors are only addressed in one study, such as *communication* which is only mentioned by De Waal & Stremke [58]. Scognamiglio [32] mentions seventeen factors for acceptance of 'photovoltaic landscapes' (designed large-scale solar power plants). Landscape design studies very often mention *community involvement & participation*. Other often mentioned factors are: *aesthetics & scenic quality*, *community values*, *environmental concerns*, and *perception of landscape change*.

4.2. Similarities and differences between fields

When comparing both fields, 25 factors are literally similar or can be interpreted similarly (Table 1). Several factors are mentioned using the exact same term, such as *visual impact*, *place attachment*, and *nuisance*. Some factors seem to be similar but use a different term, such as *energy security* and *stable energy provision*. Most mentioned factors in both fields are *community involvement & participation*, *economic benefits*, *visual impact*, *aesthetics & scenic quality*, and *environmental impact*.

We found a total of 45 factors that are only mentioned in the field of acceptance studies, such as *health & well-being*, *site selection, temporal dimension, transparency*, *fairness*, and *trust*. When the factors *trust* and related factors *trust in developer, trust in politics & institutions* are added together these are often mentioned in the acceptance studies. Moreover, these studies often argue that trust (and related terms) is a determining factor for local support or resistance towards renewable energy projects [41]. The absence of this factor in the landscape design studies is interesting, because *trust* influences local attitudes which, in turn, relates to the possibilities for *community involvement & participation*. The latter is very often mentioned as a factor in the landscape design studies (Table 2). While *community involvement & participation* is the most mentioned factor in landscape design studies it is only sometimes mentioned in the acceptance studies. The landscape design studies list sixteen factors that are not mentioned in the acceptance studies, such as *designing renewable energy landscapes, close collaboration with local authorities*, and *ecosystem services*. Furthermore, landscape design studies have a stronger focus on factors such as *environmental concerns* and *perception of landscape change*. Acceptance studies on renewable energy, on the other hand, focus more on factors such as *health & well-being*, *process*, and *site selection*.

4.3. Comparison of categorized factors

Lastly, we categorized the factors according to the four dimensions of the sustainable energy landscape framework [4] (Table 3), and to the conceptual framework of community acceptance [15] (Table 4). When we compare these categorizations some differences in focus on certain

Table 2
Comparison between the fields of acceptance studies and landscape design studies on the frequency of appearance of references to factors (purple: only mentioned in acceptance field; green: only mentioned in landscape design field). Table shows factors with largest difference, full overview in Appendix A.

Factor	Acceptance field	Landscape design field
Health & well-being	sometimes	never
Process	sometimes	never
Site selection	sometimes	never
Temporal dimension	sometimes	never
Transparency	sometimes	never
Moral & ethical values	sometimes	never
Design	sometimes	never
Landscape characteristics	sometimes	never
Trust	sometimes	never
Visibility	sometimes	never
Landscape values	sometimes	seldom
Decision making	sometimes	seldom
Procedural justice	sometimes	seldom
Perception of landscape change	sometimes	often
Environmental concerns	sometimes	often
Close collaboration with local authorities	never	sometimes
Involving farmers	never	sometimes
Landscape architect as facilitator	never	sometimes
Multifunctional land-use	never	sometimes
Designing renewable energy landscapes	never	sometimes
Community involvement & participation	sometimes	very often

Table 3
Factors sorted according to dimensions of the sustainable energy landscapes framework [4].

Aspect	Factors	% of factors mentioned in acceptance field	% of factors mentioned in landscape design field	Same factors (%)
Sustainable technical	Air pollution; business model; construction; cumulative impacts; design; economic sustainability; (cost) efficient; end-of-life; energy security; functional efficiency; light pollution; noise pollution; physical characteristics of energy alternative; project details; project size; quality of energy provision; safety of plant; stable energy provision; technology; temporal dimension; traffic;	27 %	7 %	5 %
Environmental	CO_2 emissions; ecological compensation; ecosystem services; environmental concerns; environmental impact; geographical location; landscape characteristics; landscape modification; wildlife habitats & -creation;	11 %	17 %	36 %
Economic	Economic benefits; economic impact; impact on agricultural land use; jobs; multifunctional land-use; price; property values; regional added value; tourism	12 %	12 %	44 %
Socio-cultural	Aesthetics & scenic value; alternative options; attitudes; close collaboration with local authorities; communication; community involvement & participation; community values; cultural heritage; decision making; demographic characteristics; designing RE landscapes; fairness; forced expansion; health & well-being; inclusive bottom-up processes; information; involving farmers; key role of cultural and public associations; knowledge & understanding of RET; landscape architect as facilitator; landscape narrative; landscape quality; landscape values; legacy; local initiative & energy cooperation; mitigation measures; moral & ethical values; multi-stakeholder processes; NIMBY; nuisance; perception of landscape change; perception of risk; place attachment; procedural justice; process; social values; recreation & community activities; site selection; transparency; trust; trust in developer; trust in politics & institutions; visibility; visual impact; visual preference.	50 %	64 %	36 %

Table 4
Factors sorted according to main factors of the community acceptance framework [15].

Main factor	Factors	% of factors mentioned in acceptance field	% of factors mentioned in landscape design field	Same factors (%)
Project details	Business model; design; economic sustainability; (cost) efficient; end-of-life; energy security; functional efficiency; geographical location; physical characteristics of energy alternative; project details; project size; quality of energy provision; safety of plant; stable energy provision; technology;	19 %	7 %	7 %
Construction	Air pollution; construction; cumulative impacts; light pollution; noise pollution; traffic;	8 %	0 %	0 %
Environmental	CO_2 emissions; ecological compensation; ecosystem services; environmental concerns; environmental impact; environmental justice; flooding; landscape modification; wildlife habitats & -creation;	9 %	17 %	44 %
Temporal	Cultural heritage; landscape narrative; landscape quality; landscape values; legacy; perception of landscape change; temporal dimension;	9 %	10 %	43 %
Economic	Economic benefits; economic impact; impact on agricultural land use jobs; multifunctional land-use; price; property values; regional added value; tourism;	11 %	12 %	44 %
Process	alternative options; close collaboration with local authorities; communication; community involvement & participation; decision making; designing RE landscapes; fairness; forced expansion; inclusive bottom-up processes; information; involving farmers; key role of cultural and public associations; landscape architect as facilitator; local initiative & energy cooperation; mitigation measures; multi-stakeholder process; procedural justice; process; site selection; transparency; trust; trust in developer; trust in politics & institutions;	20 %	32 %	17 %
Social	Attitudes (towards RE); community values; demographic characteristics; health & well-being; knowledge & understanding of RET; moral & ethical values; NIMBY; perception of risk; place attachment; social values; recreation & community activities;	16 %	15 %	55 %
Aesthetic	Aesthetics & scenic value; landscape characteristics; nuisance; visibility; visual impact; visual preference.	8 %	7 %	50 %

aspects between both fields become visible (Fig. 4). Analysing the results with the framework on sustainable energy landscapes [4] we find a similar focus in amount of factors related to economic aspects. However, acceptance studies tend to give more attention to sustainable technical aspects (20 % difference), while landscape design studies tend to give more attention to social (14 % difference) and environmental aspects (6

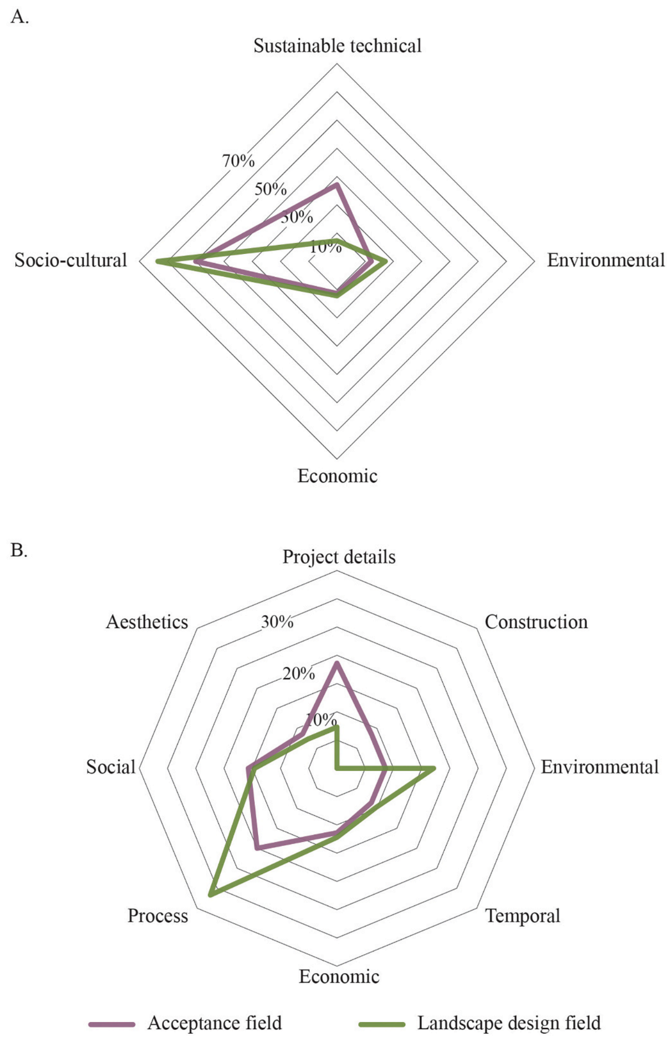

Fig. 4. Factors categorized according to the conceptual frameworks of (A) sustainable energy landscape [4] and (B) community acceptance [15].

% difference). Interestingly the category of social aspects is in both fields much larger than the other three aspects, demonstrating a strong focus in peer-reviewed literature on social and/or process related factors. When sorting the factors to the main factors of community acceptance [15] we find some alignments in the focus on the main factors aesthetic, economic, social, and temporal. However, acceptance studies have a stronger emphasis on the main factors construction (8 % difference), and project details (12 % difference). Landscape design studies have a stronger emphasis on environmental (8 % difference), and process (12 % difference) factors. In this framework the process factors have the largest representation of related factors. This presents an alignment between both fields on the attention for involvement of local stakeholders and the effect of process on support or opposition of renewable energy projects.

5. Discussion & conclusion

In this systematic literature review we studied two fields of research - acceptance studies and landscape design studies - on the factors that influence the local acceptance of renewable energy projects. We study how these fields currently acknowledge each other, what overlaps exist between the fields in terminology and considered topics, and where the fields could strengthen each other in the future. This study contributes to the theoretical synthesis between two fields of research and to the empirical knowledge on the acceptance of renewable energy.

In our literature review we found 86 different terms that describe a factor for the acceptance of renewable energy projects (Table 1). The literature clearly shows that the discussion on these factors is still ongoing. Across both fields, but also within individual studies, much variation exists in the interpretation of factors as well as which factors are included or excluded when studying local support or opposition towards renewable energy projects. Nevertheless, we identified 25 factors mentioned both in acceptance and landscape design studies. This indicates that there is some alignment between both fields with regards to somewhat general factors, such as *economic benefits*, *visual impact*, and *aesthetics & scenic quality* (Table 1; Appendix A). We also illustrated that the attention to the factors differs for the two fields (Table 2) and that there is no consensus yet on which factors to include when examining the acceptance of renewable energy projects. These similarities and differences become visible as well when comparing the results from the peer-reviewed literature with two conceptual frameworks. We found that both fields focus strongly on the socio-cultural dimension of the sustainable energy landscape framework [4]. Moreover, both fields seem to place a similar emphasis on temporal, economic, social, and aesthetic factors when comparing the main factors to the community acceptance framework [15]. This indicates some alignment between the acceptance studies and studies on landscape design (Table 4; Fig. 4). However, the fields differ significantly as following.

The absence of certain factors in one field or the other is interesting. Especially when referring to factors that are frequently addressed in one field, such as *trust* (and related terms) as a factor in acceptance studies and *community involvement & participation* in landscape design studies. A stronger consideration of these factors in both fields, one could argue, is beneficial for the local acceptance of renewable energy projects. Landscape architects that are conscious about the factor *trust* will gain a better understanding of the local situation and relations among the stakeholders. Social scientists could study the factor *process* more thoroughly, examining if more inclusive design processes indeed influence the local acceptance of renewable energy projects [6]. That is not to say that public engagement will secure public support for renewable energy developments [47].

Moreover, when we compare the scholarly research foci to the findings of the case study by Roddis et al. [15] (Section 2.2) we detect large differences in emphasis placed on factors by scholars and laypersons. It seems that laypersons place a stronger emphasis on the factor environmental (18 % difference), while peer-reviewed literature places more emphasis on the factor process (17 % difference). One explanation for this could be that local stakeholders are imbedded in some process but do not adjust or improve this process themselves, making them pay less attention to this factor. Researchers, on the contrary, more frequently study processes or approaches for the implementation of renewable energy projects. Nevertheless, these differences in emphasis between laypersons and scholars raises the question if the current research agenda on landscape transformation and acceptance of renewable energy is addressing the most relevant challenges and if not more attention should be given to environmental factors. At the same time, Olson-Hazboun et al. [66] argue that future research on acceptance of renewable energy should not predominantly focus on environmental concerns and beliefs, because this would further increase the polarizing views in society on renewable energy development as response to environmental and/or climate change concerns. However, if public support is indeed a key for the transition to renewable energy sources, as suggested by e.g. Schumacher et al. [12], it will be necessary to critically reflect on the present day attention of many scholars to a selected group of factors.

In our study, we encountered some difficulties in dealing with the differences in focus and variety in terms used for factors. The difference in terms used is partly explained by the specificity of some factors with respect to the different (spatial) scale levels, as well as by differences in scope and geographic context. Because of this variety in terms, one cannot claim to have a complete overview of all possible factors for the acceptance of renewable energy projects. In this context, it must be stressed that we analysed the identified literature until we did not find additional factors anymore. Another limitation of the study is that it was not possible to compare studies on the weight or importance they assign to a certain factor, because not all studies include the same factors and not all studies assign clear weight or importance to the factors they consider. Lastly, some terms can be interpreted differently or it could be argued that they can be categorized differently. However, the most frequently returning factors were clearly defined and could be found in both fields; they are represented in the lists and comparison of factors.

When we study the references to the process of designing renewable energy landscapes, we find that this is not frequently mentioned in peer-reviewed literature. Design is seldom referred to in the acceptance studies on renewable energy. Moreover, these studies do not necessarily relate to the process or refer to the possibilities of designing renewable energy landscapes. For acceptance studies this could be explained by the temporal setting of most papers. Although it is acknowledged that acceptance of renewable energy can change over time [38], most studies tend to focus on a certain moment in time. We found that most acceptance studies do not focus on the design phase, but either study the moment before a change will take place (e.g. [7,61,62]) or the moment when a landscape transformation has happened (e.g. [63]). This differs from the practice of landscape design, which interprets landscape as an ever-changing phenomenon, recognizing a past, present and future, of which the latter can be influenced and designed. Design professionals are engaged in the moment of transition and therefore experience the influence the process has on the designed situation. Designing for energy transition is mentioned in the landscape design studies only a few times. However, several studies do refer to factors that can be related to the design process such as *community involvement & participation*, *multi-stakeholder process*, *inclusive bottom-up process*, and *landscape architect as facilitator*. Scognamiglio [32] stresses the importance of landscape design and the potential effect of design on the local support of in her case solar power plants. Additionally, Stremke & Picchi [65] address the possibilities of co-designing renewable energy landscapes and stress the importance of including all local stakeholders during this process. The limited literature and empirical research on the connection between landscape design and acceptance of renewable energy demonstrates a clear knowledge gap. Future research should, among others, examine the influence of involving landscape designers on the acceptance of renewable energy projects and examine the effect of more inclusive design processes.

In addition, our study presents relevant findings for current renewable energy infrastructure planning and development. When we examine the factors we find several factors that highlight opportunities to be addressed in current practice. For example, the factor *health & well-being*, which is often mentioned in the acceptance studies, but not mentioned in landscape design studies (Table 2). A stronger consideration of *health & well-being* in the design could have spatial implications for the landscape design. Moreover, *health & well-being* should be considered by landscape architects as an influence on local acceptance of renewable energy projects. Another factor that stands out is *site selection*. For an optimal landscape design of renewable energy projects, the *site selection* and related *decision making* should be part of the landscape design process [5]. Moreover, the *process* itself could get more attention. Many factors in the landscape design studies refer to the processes [21,22,55–57], including factors such as *close collaboration with local authorities*, *inclusive bottom-up process*, and *key role of cultural and public associations*. The attention to these factors in both fields varies, but the literature suggest that a better implementation of these factors would positively influence local support of renewable energy projects giving these initiatives a higher probability to be implemented.

In conclusion, the literature review illustrates that there is no consensus yet on which factors influence the acceptance of renewable energy projects, and to what extent they influence acceptance. Both fields, acceptance studies and landscape design studies, would benefit from a clearer definition of factors and further case studies that illustrate the weight or importance of factors for the acceptance of specific renewable energy projects. Future research should, among others, examine the influence of involving landscape architects and other designers on the acceptance of renewable energy projects; to explore for example the effect of more inclusive design processes on factors such as *trust*. More knowledge on a wide range of factors influencing the acceptance of renewable energy projects and intensified collaboration between social scientists and landscape architects is paramount to succeed in the quest for energy projects that are embraced by landscape users and to realize procedural justice in the transition towards a post carbon future.

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.

Data availability

Data will be made available on request.

Acknowledgements

Last, we would like to express our sincere gratitude for the role of Adri van den Brink in the development of this research. To our deepest regret Adri passed away during the writing of this paper. Here, we commemorate his enthusiasm, conceptual thinking and sharp questions that have contributed to the realization of this paper.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Appendix A. Overview of factors of acceptance of renewable energy

Ordered to relative difference between fields.

Only mentioned in Acceptance field

Only mentioned in Landscape design field

	Acceptance field																											Landscape design field															Both fields
Factors ↓ Study →	Bertsch et al. (2016)	Bevk & Golobic (2020)	Calvert et al. (2019)	Caporale et al. (2020)	Devine-Wright (2013)	Fast (2013)	Ferrario & Castiglioni (2017)	Firestone et al. (2018)	Gölz & Wedderhoff (2018)	Horbaty et al. (2012)	Keilty et al. (2016)	Ketzer et al. (2020a)	Kontogianni et al. (2014)	Liebe & Dobers (2019)	Lothian (2020)	Pasqualetti (2011a)	Perlaviciute & Steg (2014)	Petrova (2016)	Roddis et al. (2020)	Sherren et al. (2019)	Spaeth (2018)	Spielhofer et al. (2021b)	Terrapon-Pfaff et al. (2019)	Wolsink (2007)	Zoellner et al. (2008)	Total references in field (n)	Studies mention factor in field	Bosch et al. (2020)	Oudes & Stremke (2020)	Lobaccaro et al. (2019)	Picchi et al. (2019)	Stremke & Schöbel (2019)	Oudes & Stremke (2018)	Picchi (2018)	Scoglamiglio (2016)	De Waal et al. (2015)	Ozgun et al. (2015)	De Waal & Stremke (2014)	Stremke & Koh (2011)	Selman (2010)	Total references in field (n)	Studies mention factor in field	Studies mention factor
Health & well-being	1									1			1						1	1			1			6	sometimes													0	never	seldom
Moral & ethical values		1							1		1					1	1								1	6	sometimes													0	never	seldom
Process		1		1				1			1								1						1	6	sometimes													0	never	seldom
Site selection				1		1						1	1				1								1	6	sometimes													0	never	seldom
Temporal dimension		1	1				1				1								1					1		6	sometimes													0	never	seldom
Transparency				1			1	1		1									1						1	6	sometimes													0	never	seldom
Design		1		1								1			1				1							5	sometimes													0	never	seldom
Landscape characterisitcs		1										1				1			1					1		5	sometimes													0	never	seldom
Trust												1	1				1		1					1		5	sometimes													0	never	seldom
Visibility (distance)		1				1	1						1							1						5	sometimes													0	never	seldom
Economic benefits	1			1		1		1		1		1	1			1	1				1		1		1	12	often	1	1	1							1	1			5	sometimes	often
Visual impact		1				1	1			1		1			1			1	1	1				1	1	11	often				1	1			1			1		1	5	sometimes	often
Environmental impact					1	1	1			1			1				1	1	1		1		1		1	11	often		1		1				1			1			4	sometimes	sometimes
Landscape values			1			1		1			1					1		1	1					1		8	sometimes				1										1	seldom	sometimes
Decision making				1		1		1		1			1										1	1		7	sometimes							1							1	seldom	sometimes
Procedural justice					1			1		1						1	1	1							1	7	sometimes								1						1	seldom	sometimes
Communication	1					1		1		1			1														5	sometimes									1					1	seldom	seldom
Cultural heritage											1					1			1					1		4	seldom													0	never	seldom
Demographic characteristics	1												1	1						1						4	seldom													0	never	seldom
Fairness							1	1	1															1		4	seldom													0	never	seldom
Information	1			1							1														1	4	seldom													0	never	seldom
Regional added value									1	1	1												1			4	seldom													0	never	seldom
Technology		1										1							1						1	4	seldom													0	never	seldom
Trust in developer					1			1															1		1	4	seldom													0	never	seldom
(Cost) efficient				1																	1				1	3	seldom													0	never	seldom
Geographical locations	1			1																1						3	seldom													0	never	seldom
Impact on agricultural land use											1								1				1			3	seldom													0	never	seldom
Property values										1	1								1							3	seldom													0	never	seldom
Safety of plant	1																1						1			3	seldom													0	never	seldom
Social values																1			1				1			3	seldom													0	never	seldom
Tourism										1	1								1							3	seldom													0	never	seldom
Air pollution	1																		1							2	seldom													0	never	seldom
Construction		1																	1							2	seldom													0	never	seldom
End-of-life											1								1							2	seldom													0	never	seldom
Landscape modification	1																								1	2	seldom													0	never	seldom
Noise pollution	1																		1							2	seldom													0	never	seldom
Physical characteristics of energy alternative																	1								1	2	seldom													0	never	seldom
Project details												1							1							2	seldom													0	never	seldom
Trust in politics & institutions				1							1															2	seldom													0	never	seldom
Alternative options																			1							1	seldom													0	never	seldom
Business model																			1							1	seldom													0	never	seldom
Cumulative impacts																			1							1	seldom													0	never	seldom
Flooding																			1							1	seldom													0	never	seldom
Functional efficiency				1																						1	seldom													0	never	seldom
Legacy																			1							1	seldom													0	never	seldom
Light pollution																			1							1	seldom													0	never	seldom
Mitigation measures																			1							1	seldom													0	never	seldom
NIMBY														1												1	seldom													0	never	seldom
Quality of energy provision																	1									1	seldom													0	never	seldom
Stable energy provision				1																						1	seldom													0	never	seldom
Traffic (nuisance caused by the construction)																			1							1	seldom													0	never	seldom
Visual preference																						1				1	seldom													0	never	seldom
Wildlife habitats & -creation				1						1								1	1							4	seldom				1										1	seldom	seldom
CO2 emissions				1															1							2	seldom			1											1	seldom	seldom
Knowledge & understanding of RET						1																	1			2	seldom										1			1	2	seldom	seldom
Perception of risk																1										1	seldom								1						1	seldom	seldom
Price						1											1									2	seldom	1													1	seldom	seldom
Nuisance (light, glare, noise)				1				1		1			1					1	1				1	1		8	sometimes			1					1			1			3	sometimes	sometimes
Economic impact	1				1			1		1															1	5	sometimes								1		1	1			3	sometimes	sometimes
Jobs										1	1		1						1				1			5	sometimes	1		1					1						3	sometimes	sometimes
Place attachment					1	1	1							1			1		1							6	sometimes	1							1				1	1	4	sometimes	sometimes
Economic sustainability (business case)																										0	never										1				1	seldom	seldom
Energy security																										0	never								1						1	seldom	seldom
Forced expansion will undermine acceptance																										0	never	1													1	seldom	seldom
Key role of cultural and public associations																										0	never			1											1	seldom	seldom
Landscape narrative																										0	never													1	1	seldom	seldom
Local initiatives & energy cooperation																										0	never							1							1	seldom	seldom
Multi-stakeholder process																										0	never					1									1	seldom	seldom
Ecological compensation																										0	never	1												1	2	seldom	seldom
Ecosystem services																										0	never				1			1						2	seldom	seldom

Only mentioned in Acceptance field

Only mentioned in Landscape design field

Factors ↓ Study →	Acceptance field																											Landscape design field															Both fields
	Bertsch et al. (2016)	Bevk & Golobic (2020)	Calvert et al. (2019)	Caporale et al. (2020)	Devine-Wright (2013)	Fast (2013)	Ferrario & Castiglioni (2017)	Firestone et al. (2018)	Gölz & Wedderhoff (2018)	Horbaty et al. (2012)	Keilty et al. (2016)	Ketzer et al. (2020a)	Kontogianni et al. (2014)	Liebe & Dobers (2019)	Lothian (2020)	Pasqualetti (2011a)	Perlaviciute & Steg (2014)	Petrova (2016)	Roddis et al. (2020)	Sherren et al. (2019)	Spaeth (2018)	Spielhofer et al. (2021b)	Terrapon-Pfaff et al. (2019)	Wolsink (2007)	Zoellner et al. (2008)	Total references in field (n)	Studies mention factor in field	Bosch et al. (2020)	Oudes & Stremke (2020)	Lobaccaro et al. (2019)	Picchi et al. (2019)	Stremke & Schöbel (2019)	Oudes & Stremke (2018)	Picchi (2018)	Scoglamiglio (2016)	De Waal et al. (2015)	Ozgun et al. (2015)	De Waal & Stremke (2014)	Stremke & Koh (2011)	Selman (2010)	Total references in field (n)	Studies mention factor in field	Studies mention factor
Environmental (in)justice																										0	never	1	1												2	seldom	seldom
Inclusive and bottom-up processes																										0	never							1		1					2	seldom	seldom
Attitudes (towards RE)								1						1		1								1		4	seldom				1			1	1						3	sometimes	seldom
Landscape quality												1			1							1		1		4	seldom		1			1					1	1			4	sometimes	sometimes
Project size																			1							1	seldom							1	1					1	3	sometimes	seldom
Recreation and community activities																			1							1	seldom				1						1			1	3	sometimes	seldom
Aesthetics & scenic quality			1		1		1	1			1				1				1	1		1				9	sometimes		1		1	1	1					1		1	6	often	sometimes
Community values								1		1	1				1						1		1	1		7	sometimes		1		1	1	1		1					1	6	often	sometimes
Perception of landscape change						1	1				1			1		1						1				6	sometimes	1			1	1		1	1					1	6	often	sometimes
Environmental concerns	1													1		1				1			1			5	sometimes	1	1	1	1				1					1	6	often	sometimes
Collaboration with local authorities																										0	never		1	1								1			3	sometimes	seldom
Involving farmers																										0	never			1						1		1			3	sometimes	seldom
Landscape architects as facilitator																										0	never					1		1				1			3	sometimes	seldom
Multifunctional land-use																										0	never		1		1				1						3	sometimes	seldom
Designing RE landscapes																										0	never						1		1		1	1			4	sometimes	seldom
Community involvement & participation						1	1			1		1	1								1			1		7	sometimes		1	1	1		1	1	1	1	1	1		1	10	very often	often

References

[1] G. Bridge, S. Bouzarovski, M. Bradshaw, N. Eyre, Geographies of energy transition: space, place and the low-carbon economy, Energy Policy 53 (Feb. 2013) 331–340, https://doi.org/10.1016/J.ENPOL.2012.10.066.

[2] A. Nadaï, D. Van Der Horst, Introduction: landscapes of energies, Landsc. J. 35 (2) (2010) 143–155, https://doi.org/10.1080/01426390903557543.

[3] M. Pasqualetti, S. Stremke, Energy landscapes in a crowded world: a first typology of origins and expressions, Energy Res. Soc. Sci. 36 (Feb. 2018) 94–105, https://doi.org/10.1016/J.ERSS.2017.09.030.

[4] S. Stremke, Sustainable energy landscape: implementing energy transition in the physical realm, in: S.E. Jorgensen (Ed.), Encyclopedia of Environmental Management, 1st ed., CRC Press, 2015.

[5] D. Apostol, J. Palmer, M. Pasqualetti, R. Smardon, R. Sullivan, The Renewable Energy Landscape: Preserving Scenic Values in our Sustainable Future, Routledge, New York, 2017.

[6] T. Bevk, M. Golobič, Contentious eye-catchers: perceptions of landscapes changed by solar power plants in Slovenia, Renew. Energy 152 (Jun. 2020) 999–1010, https://doi.org/10.1016/J.RENENE.2020.01.108.

[7] B. Sütterlin, M. Siegrist, Public acceptance of renewable energy technologies from an abstract versus concrete perspective and the positive imagery of solar power, Energy Policy 106 (Jul. 2017) 356–366, https://doi.org/10.1016/J.ENPOL.2017.03.061.

[8] R. Wüstenhagen, M. Wolsink, M.J. Bürer, Social acceptance of renewable energy innovation: an introduction to the concept, Energy Policy 35 (5) (May 2007) 2683–2691, https://doi.org/10.1016/J.ENPOL.2006.12.001.

[9] S. Gölz, O. Wedderhoff, Explaining regional acceptance of the german energy transition by including trust in stakeholders and perception of fairness as socio-institutional factors, Energy Res. Soc. Sci. 43 (Sep. 2018) 96–108, https://doi.org/10.1016/J.ERSS.2018.05.026.

[10] M.A. Hai, Rethinking the social acceptance of solar energy: exploring 'states of willingness' in Finland, Energy Res. Soc. Sci. 51 (May 2019) 96–106, https://doi.org/10.1016/J.ERSS.2018.12.013.

[11] K. Langer, T. Decker, K. Menrad, Public participation in wind energy projects located in Germany: which form of participation is the key to acceptance? Renew. Energy 112 (Nov. 2017) 63–73, https://doi.org/10.1016/J.RENENE.2017.05.021.

[12] K. Schumacher, F. Krones, R. McKenna, F. Schultmann, Public acceptance of renewable energies and energy autonomy: a comparative study in the french, german and swiss upper Rhine region, Energy Policy 126 (Mar. 2019) 315–332, https://doi.org/10.1016/J.ENPOL.2018.11.032.

[13] P. Devine-Wright, S. Batel, Explaining public preferences for high voltage pylon designs: an empirical study of perceived fit in a rural landscape, Land Use Policy 31 (Mar. 2013) 640–649, https://doi.org/10.1016/J.LANDUSEPOL.2012.09.011.

[14] G. Perlaviciute, L. Steg, Contextual and psychological factors shaping evaluations and acceptability of energy alternatives: integrated review and research agenda, Renew. Sust. Energ. Rev. 35 (Jul. 2014) 361–381, https://doi.org/10.1016/J.RSER.2014.04.003.

[15] P. Roddis, K. Roelich, K. Tran, S. Carver, M. Dallimer, G. Ziv, What shapes community acceptance of large-scale solar farms? A case study of the UK's first 'nationally significant' solar farm, Sol. Energy 209 (Oct. 2020) 235–244, https://doi.org/10.1016/J.SOLENER.2020.08.065.

[16] K. Keilty, T.M. Beckley, K. Sherren, Baselines of acceptability and generational change on the mactaquac hydroelectric dam headpond (New Brunswick, Canada), Geoforum 75 (Oct. 2016) 234–248, https://doi.org/10.1016/J.GEOFORUM.2016.08.001.

[17] M.J. Pasqualetti, Reading the changing energy landscape, in: S. Stremke, A. Van den Dobbelsteen (Eds.), Sustainable Energy Landscapes, CRC Press, 2012, pp. 11–44.

[18] M.A. Petrova, From NIMBY to acceptance: toward a novel framework - VESPA - for organizing and interpreting community concerns, Renew. Energy 86 (Feb. 2016) 1280–1294, https://doi.org/10.1016/J.RENENE.2015.09.047.

[19] R. Spielhofer, M. Hunziker, F. Kienast, U. Wissen Hayek, A. Grêt-Regamey, Does rated visual landscape quality match visual features? An analysis for renewable energy landscapes, Landsc. Urban Plan. 209 (May 2021) 1–21, https://doi.org/10.1016/J.LANDURBPLAN.2020.104000.

[20] V. Bertsch, M. Hall, C. Weinhardt, W. Fichtner, Public acceptance and preferences related to renewable energy and grid expansion policy: empirical insights for Germany, Energy 114 (Nov. 2016) 465–477, https://doi.org/10.1016/J.ENERGY.2016.08.022.

[21] R.M. De Waal, S. Stremke, A. Van Hoorn, I. Duchhart, A. Van Den Brink, Incorporating renewable energy science in regional landscape design: results from a competition in the Netherlands, Sustainability 7 (5) (2015) 4806–4828, https://doi.org/10.3390/SU7054806.

[22] P. Picchi, Why energy democracy can enhance landscape democracy in the energy transition: some reflections on the italian case, Ri-Vista 2 (2018) 14–33, https://doi.org/10.13128/RV-24892.

[23] S. Stremke, S. Schöbel, Research through design for energy transition: two case studies in Germany and the Netherlands, Smart Sustain. Built Environ. 8 (1) (2019) 16–33, https://doi.org/10.1108/SASBE-02-2018-0010.

[24] M. Van den Brink, J. Edelenbos, A. Van den Brink, S. Verweij, R. Van Etteger, T. Busscher, To draw or to cross the line? The landscape architect as boundary spanner in dutch river management, Landsc. Urban Plan. 186 (Jun. 2019) 13–23, https://doi.org/10.1016/J.LANDURBPLAN.2019.02.018.

[25] B.K. Sovacool, J. Axsen, S. Sorrell, Promoting novelty, rigor, and style in energy social science: towards codes of practice for appropriate methods and research design, Energy Res. Soc. Sci. 45 (Nov. 2018) 12–42, https://doi.org/10.1016/J.ERSS.2018.07.007.

[26] R.Z. DeLue, J. Elkins, Landscape Theory, Routledge, New York, 2008.

[27] E.J. Palka, Coming to grips with the concept of landscape, Accessed: Oct. 19, 2021. [Online]. Available: Landsc. J. 14 (1) (1995) 63–73 https://www.jstor.org/stable/pdf/43323316.pdf.

[28] Council of Europe, no. 176, in: European Landscape Convention, Florence, 20 October 2000, 2000, p. 26. p.

[29] P. Selman, Learning to love the landscapes of carbon-neutrality, Landsc. Res. 35 (2) (Apr. 2010) 157–171, https://doi.org/10.1080/01426390903560414.

[30] P. Picchi, M. van Lierop, D. Geneletti, S. Stremke, Advancing the relationship between renewable energy and ecosystem services for landscape planning and design: a literature review, Ecosyst. Serv. 35 (Feb. 2019) 241–259, https://doi.org/10.1016/j.ecoser.2018.12.010.

[31] S. Bosch, M. Schmidt, D. Kienmoser, On the path to sustainable energy landscapes? The social shaping of energy landscapes in the face of climate protection measures, Erdkunde 74 (4) (2020) 263–280, https://doi.org/10.3112/erdkunde.2020.04.03.

[32] A. Scognamiglio, 'Photovoltaic landscapes': design and assessment. A critical review for a new transdisciplinary design vision, Renew. Sust. Energ. Rev. 55 (Mar. 2016) 629–661, https://doi.org/10.1016/j.rser.2015.10.072.

[33] D. Oudes, S. Stremke, Climate adaptation, urban regeneration and brownfield reclamation: a literature review on landscape quality in large-scale transformation projects, Landsc. Res. 45 (7) (Oct. 2020) 905–919, https://doi.org/10.1080/01426397.2020.1736995.

[34] 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, 2013, pp. 45–67.

[35] D. Oudes, S. Stremke, Spatial transition analysis: spatially explicit and evidence-based targets for sustainable energy transition at the local and regional scale, Landsc. Urban Plan. 169 (Jan. 2018) 1–11, https://doi.org/10.1016/J.LANDURBPLAN.2017.07.018.

[36] J.J. Cohen, J. Reichl, M. Schmidthaler, Re-focussing research efforts on the public acceptance of energy infrastructure: a critical review, Energy 76 (Nov. 2014) 4–9, https://doi.org/10.1016/J.ENERGY.2013.12.056.

[37] I. Bailey, J. West, I. Whitehead, Out of sight but not out of Mind? Public perceptions of wave energy, J. Environ. Policy Plan. 13 (2) (Jun. 2011) 139–157, https://doi.org/10.1080/1523908X.2011.573632.

[38] M. Wolsink, Planning of renewables schemes: deliberative and fair decision-making on landscape issues instead of reproachful accusations of non-cooperation, Energy Policy 35 (5) (May 2007) 2692–2704, https://doi.org/10.1016/J.ENPOL.2006.12.002.

[39] P. Devine-Wright, S. Batel, O. Aas, B. Sovacool, M.C. LaBelle, A. Ruud, A conceptual framework for understanding the social acceptance of energy infrastructure: insights from energy storage, Energy Policy 107 (Aug. 2017) 27–31, https://doi.org/10.1016/J.ENPOL.2017.04.020.

[41] P. Devine-Wright, Explaining 'NIMBY' objections to a power line: the role of personal, place attachment and project-related factors, Environ. Behav. 45 (6) (2012) 761–781, https://doi.org/10.1177/0013916512440435.

[42] B.K. Sovacool, P.L. Ratan, Conceptualizing the acceptance of wind and solar electricity, Renew. Sust. Energ. Rev. 16 (7) (Sep. 2012) 5268–5279, https://doi.org/10.1016/J.RSER.2012.04.048.

[43] M. Cordoves-Sánchez, A. Vallejos-Romero, Social construction of risk in non-conventional renewable energy: risk perception as a function of ecosystem services in La Araucanía, Chile, Ecol. Econ. 159 (May 2019) 261–270, https://doi.org/10.1016/J.ECOLECON.2019.01.031.

[44] J. De Boer, C. Zuidema, K. Gugerell, New interaction paths in the energy landscape: the role of local energy initiatives, Landsc. Res. 43 (4) (May 2018) 489–502, https://doi.org/10.1080/01426397.2018.1444154.

[45] J. Zoellner, P. Schweizer-Ries, C. Wemheuer, Public acceptance of renewable energies: results from case studies in Germany, Energy Policy 36 (11) (Nov. 2008) 4136–4141, https://doi.org/10.1016/J.ENPOL.2008.06.026.

[46] J. Firestone, B. Hoen, J. Rand, D. Elliott, G. Hübner, J. Pohl, Reconsidering barriers to wind power projects: community engagement, developer transparency and place, J. Environ. Policy Plan. 20 (3) (May 2018) 370–386, https://doi.org/10.1080/1523908X.2017.1418656.

[47] P. Devine-Wright, Reconsidering public acceptance of renewable energy technologies: a critical review, in: T. Jamasb, M. Grubb, M. Pollitt (Eds.), Delivering a Low Carbon Electricity System: Technologies, Economics and Policy, Cambridge University Press, 2008.

[48] M.J. Grant, A. Booth, A typology of reviews: an analysis of 14 review types and associated methodologies, Health Inf. Libr. J. 26 (2) (Jun. 2009) 91–108, https://doi.org/10.1111/J.1471-1842.2009.00848.X.

[49] W. Mengist, T. Soromessa, G. Legese, Method for conducting systematic literature review and meta-analysis for environmental science research, MethodsX 7 (Jan. 2020) 1–11, https://doi.org/10.1016/J.MEX.2019.100777.

[50] M. Petticrew, H. Roberts, Systematic Reviews in the Social Sciences: A Practical Guide, Blackwell Publishing Ltd, 2008.

[51] R. Kumar, Research Methodology : A Step-by-Step Guide for Beginners, 4th ed., Sage, Los Angeles, 2014.

[52] D. Gough, S. Oliver, J. Thomas, in: An Introduction to Systematic Reviews, Sage, London, 2017, p. 331.

[53] J. Popay, Guidance on the Conduct of Narrative Synthesis in Systematic Reviews: A Product From the ESRC Methods Programme, 2006.

[54] K. Calvert, K. Greer, M. Maddison-MacFadyen, Theorizing energy landscapes for energy transition management: insights from a socioecological history of energy

transitions in Bermuda, Geoforum 102 (Jun. 2019) 191–201, https://doi.org/10.1016/J.GEOFORUM.2019.04.005.
[55] D. Ketzer, P. Schlyter, N. Weinberger, C. Rösch, Driving and restraining forces for the implementation of the agrophotovoltaics system technology – a system dynamics analysis, J. Environ. Manag. 270 (Sep. 2020) 1–11, https://doi.org/10.1016/J.JENVMAN.2020.110864.
[56] D. Caporale, V. Sangiorgio, A. Amodio, C. De Lucia, Multi-criteria and focus group analysis for social acceptance of wind energy, Energy Policy 140 (May 2020) 1–15, https://doi.org/10.1016/J.ENPOL.2020.111387.
[57] G. Lobaccaro, et al., A cross-country perspective on solar energy in urban planning: lessons learned from international case studies, Renew. Sust. Energ. Rev. 108 (Jul. 2019) 209–237, https://doi.org/10.1016/j.rser.2019.03.041.
[58] R.M. De Waal, S. Stremke, Energy transition: missed opportunities and emerging challenges for landscape planning and designing, Sustainability 6 (7) (2014) 4386–4415, https://doi.org/10.3390/su6074386.
[61] V. Ferrario, B. Castiglioni, Visibility/invisibility in the 'making' of energy landscape. Strategies and policies in the hydropower development of the piave river (Italian eastern Alps), Energy Policy 108 (2017) 829–835, https://doi.org/10.1016/J.ENPOL.2017.05.012.
[62] U. Liebe, G.M. Dobers, Decomposing public support for energy policy: what drives acceptance of and intentions to protest against renewable energy expansion in Germany? Energy Res. Soc. Sci. 47 (Jan. 2019) 247–260, https://doi.org/10.1016/J.ERSS.2018.09.004.
[63] A. Lothian, A survey of the visual impact and community acceptance of wind farms in Australia, Austrailian Plan. 56 (3) (2020) 217–227, https://doi.org/10.1080/07293682.2020.1819355.
[65] S. Stremke, P. Picchi, Co-designing energy landscapes: application of participatory mapping and GIS in the exploration of low carbon futures, in: Barry D. Solomon, K. E. Calvert (Eds.), Handbook on the Geographies of Energy, B. D, Edward Elgar Publishing, Cheltenham, 2017, pp. 368–379.
[66] S.K. Olson-Hazboun, R.S. Krannich, P.G. Robertson, Public views on renewable energy in the Rocky Mountain region of the United States: distinct attitudes, exposure, and other key predictors of wind energy, Energy Res. Soc. Sci. 21 (Nov. 2016) 167–179, https://doi.org/10.1016/j.erss.2016.07.002.