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Competing terms for complementary concepts? Acceptance and legitimacy of low-carbon energy technologies

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Competing terms for complementary concepts? Acceptance and legitimacy of low-carbon energy technologies

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Abstract

The large-scale deployment of low-carbon energy technologies is crucial for reducing greenhouse gas emissions and ideally limiting climate change. The success of this transition towards a carbon-neutral society depends on how these technologies are perceived by civil society and whether key societal stakeholders support or oppose their roll-out. Two major debates addressing this issue revolve around the concepts of acceptance and legitimacy. Acceptance literature examines the drivers and levels of support of novel technologies and socio-technical systems. Legitimacy literature captures how these technologies are aligned to their institutional environment. Thus far, there is little cross-fertilisation between the two debates. For this contribution, we conducted a systematic literature review of the two research streams to gain a better understanding of how the social dynamics of low-carbon energy technology deployment are conceptualised. Our review involved the analysis of 240 articles from SCOPUS that empirically studied the acceptance or legitimacy of low-carbon energy technologies. Our findings suggest that the two literature strands are indeed rather disconnected – few articles use both concepts conjointly. They further illustrate that both have distinct research foci and intellectual roots. Acceptance studies tend to focus on individual perspectives towards specific technologies and relate these to the individuals' backgrounds. In contrast, legitimacy studies tend to focus on the overall alignment of specific technologies or entire innovation systems with the institutional context. Based on our findings, we propose a framework, to allow for a better understanding of the dynamic interplay between macro-level legitimacy evaluations and micro-level acceptance evaluations.

Keywords:

Acceptance; Legitimacy; Public perceptions; Acceptability; Legitimation; Low-carbon energy technologies

Abbreviations

RETs	Renewable Energy Technologies
TIS	Technological Innovation System
WoS	Web of Science

1. Introduction

The use and application of low-carbon energy technologies – such as wind power plants, heat pumps, or battery storage – must rapidly accelerate to limit global warming to 1.5 °C. Whether this is successful depends in part on how the public perceives these novel technologies and whether crucial societal stakeholders resist or oppose their rollout. This issue is addressed by two major debates in the energy social sciences: The concept of *acceptance*, on the one hand, is frequently applied in disciplines such as economics, sociology, psychology, or geography [1–4]. On the other hand, research on the *legitimacy* of technologies is rooted in organisation and management studies [5] and the concept is increasingly used by scholars studying innovation systems and sustainability transitions [6,7].

At first glimpse, the two concepts seem closely related and the respective debates cover similar analytical issues. In their seminal paper on Technological Innovation Systems (TIS), Bergek et al. [8:416] even describe the process of legitimising new technologies as ‘a matter of social acceptance’. However, the debates on social acceptance and legitimacy are strongly disconnected and there is little cross-fertilisation between them in terms of exchanging conceptual and empirical insights [9]. This is related to the different ontologies of both concepts. Rohe and Chlebna [10:112193] note that ‘acceptance research has a micro-level focus on the (static) preferences of individuals, [while legitimacy research takes] a more dynamic perspective at the meso-level [focusing on] the relation between stakeholders and institutional structures and how the perceptions and actions of the former dynamically shape and are shaped by the latter’. However, this assessment is based on subjective perceptions from individual researchers and there is, to our knowledge, no systematic comparison of the two concepts. Hence, there have been calls to integrate the debates on acceptance and legitimacy as to better conceptualise social dynamics in rapidly expanding markets for low-carbon energy solutions [11,12].

In this contribution, we thus systematically review the understanding and use of both concepts within their debates. We do not focus on mapping sub-themes and debates within separated *acceptance* or *legitimacy* streams, as this has already been done elsewhere [3,13]. Instead, we focus on how the overarching concepts relate to each other and to what extent their perspectives are similar or different. Furthermore, we seek to highlight bridging ideas and concepts from both debates and to identify commonalities and complementarities. We start by presenting core concepts and themes from the literature streams (Section 2) and describe the methods and data base of our review (Section 3). We then present the findings of our literature review. In doing so, we identify commonalities and contradictions between papers concerned with acceptance and legitimacy (Section 4). Building on these findings and on the reviewed literature, we propose a framework for understanding the interplay between acceptance and legitimacy, to inform future research concerned with the public perceptions

of low-carbon energy technologies (Section 5). Section 6 concludes this review and offers an outlook for acceptance and legitimacy research.

2. An overview of two complementary concepts

This chapter briefly introduces acceptance and legitimacy research in the context of low-carbon energy technologies and summarises core conceptual contributions. Furthermore, we point to critical perspectives and blind spots of the two literature streams, as to highlight their potential complementarity.

2.1. Acceptance research

The acceptance literature aims to identify conditions for the acceptance of (energy) technologies [14]. To do so, this field of study usually relies on ex post research designs, which limits insights ‘about what potential future projects communities might accept, and why’ [15:2]. The term *acceptance* itself has been criticised for implying ‘non-agency [and] perpetuating the normative top-down perspective on people’s relations with energy infrastructures’ and for conflating acceptance of a novel technology with its support [16:2]. Yet, some studies do distinguish between different behaviours or degrees of acceptance – ranging from active opposition to enthusiastic engagement [17] – or investigate emotions associated with the technology, such as anger, fear, joy, and pride [1,18]. Consistent with these foci on individual feelings and responses, Gaede and Rowlands [3:153] observe a recent shift ‘from social acceptance as a political issue to social acceptance as a psychological issue’. This trend has been titled ‘disturbing’ and even ‘lethal’ for acceptance research by Wolsink [19] and there have been calls for a broader macro-level perspective that accounts for political and socio-technical influences [20].

Despite these criticisms, acceptance is still widely used as an umbrella term structuring broader debates on social dynamics in the context of new technologies.¹ Many researchers speak more specifically of *public* or *social* acceptance, seemingly using those terms as synonyms [3,16]. Others use public acceptance in a distinct and more specific way, capturing the collective acceptance of individual, non-expert citizens and their attitudes and behaviours [19,21]. Finally, many follow Wüstenhagen et al. [22] and distinguish specific dimensions of (social) acceptance, namely *socio-political* (the overall evaluation of technologies or policies on a general level), *market* (relating to the process of market diffusion), and *community* acceptance (the acceptance of siting decisions and specific projects by local

¹ At a [blinded] workshop, participants noted that the widely known umbrella term *acceptance* provides a gateway for social scientists to access interdisciplinary research projects and interesting empirical fields where social dynamics beyond the narrow aspect of technology acceptance can then be studied.

stakeholders). To capture the breath of the debate, we include all these terms in our subsequent literature analysis.

In light of the diversity described above, it is no surprise that the ‘concept of acceptance lacks a clear and generally agreed definition in the scientific literature’ [23:250]. For the purpose of this review, we follow a widely used definition by Upham et al. [21:103]: ‘[Acceptance is] a favourable or positive response (including attitude, intention, behaviour, and – where appropriate – use) relating to a proposed or in situ technology or socio-technical system, by members of a given social unit (country or region, community or town and household, organization)’. In this sense, acceptance refers to a relationship between a technology, as the object of acceptance, and a social group of evaluators. As *objects* of acceptance, Upham et al. [21] distinguish between energy technologies, infrastructures, or applications. Furthermore, the authors present specific actors as *evaluators* of acceptance: decision-makers from the political realm, public actors (affected citizens or the general population), and other stakeholders, such as advocacy groups or companies.

However, as we will discuss in Section 4.2., the perceptions and behaviours of individuals, which form the focal point of acceptance research, cannot be understood in isolation from the individuals’ backgrounds, i.e. the *individual order*, which is made up of the unique configuration of their relation with the object of acceptance, encompassing imprints, experiences, values, traits, and beliefs. Moreover, individuals possess varying degrees of competencies and resources to actively shape the object of acceptance, i.e. the technology or project that is to be implemented.

2.2. Legitimacy research

Legitimacy is a ‘widely used but often confusing concept’ [13:471] in sociology, social psychology, management, and organisational studies. A frequent definition holds that ‘legitimacy is a generalised perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions’ [5:574]. There are at least three aspects to this definition, which we will briefly discuss here: the object (of legitimacy), the evaluator (the subject who evaluates), and the socially constructed system.

As with the concept of acceptance, there are *objects* and *evaluators* of legitimacy. As objects, scholars analysed the legitimacy of organisations or social practices [24], or industries and technological fields [25,26]. Individuals or groups – such as organisations, government agencies, or interest groups – confer legitimacy through their evaluation, judgement, and action [27]. The difference lies primarily in the generality of this evaluation, i.e. the intersubjectivity. This is caused by the third aspect, the socially constructed system or *social order* [28]. With this system, Suchman [5] refers to established and highly objectified social structures, i.e. *institutions*, that guide and shape individual and collective behaviour

and actions within a particular social system. What is considered legitimate or illegitimate is codified in established institutions [29]. As a result, institutions allow for certain expectations of one's social environment.

Suchman [5] distinguishes three main forms of evaluation – pragmatic, moral, and cognitive legitimacy: Pragmatic legitimacy results from a self-interested cost-benefit analysis by respective evaluators. Moral legitimacy reflects a judgement on whether (organisational) outputs and procedures or technical standards are *the right thing to do* and have collective and societal benefits. Finally, cognitive legitimacy rests on a general plausibility and *taken for grantedness*, rather than a (rational) calculation about (self-)interests [5]. Furthermore, different researchers have taken various perspectives on legitimacy, investigating it as a property, process, or perception. Understood as a property, legitimacy is a collective system resource that actors can leverage to, for instance, push forward the diffusion of a technology. The process perspective highlights the social dynamics and strategies that actors take to establish, maintain, or repair the legitimacy of an organisation, practice, or technology. The perception perspective has the strongest micro-level focus as it highlights cognitive processes within individuals and collectives that result in legitimacy judgements [13]. Accordingly, this perspective is the one most strongly linked to the concept of acceptance.

In the context of low-carbon energy technologies, scholars studying processes of innovation and transition frequently apply the concept of legitimacy [30–32]. This is especially true for the TIS field. There, legitimation is either viewed as a dynamic process or system function [8], or legitimacy as a collective system resource [33]. The focal technology or the supplying industry and industry organisations have been studied as objects of legitimacy in TIS [34]. Initially, TIS literature used the concept of legitimacy inconsistently and with poor and conflicting definitions (see [10,34] for more detailed critiques). Furthermore, it was criticised that legitimacy was 'conflated with an overall indicator for system development' and that TIS studies 'ignore the micro-level determinants of legitimacy [formation]' [35:251]. However, recently some TIS studies progressed to use more fine-grained definitions of legitimacy, aiming to capture more precisely the fuzzy dynamics of legitimation [7,36,37], occasionally adding a spatial focus to the analysis [10,38].

3. Methods and data

3.1. Methods

In the previous chapter, we introduced the concepts of acceptance and legitimacy and highlighted relevant themes of our literature review. To identify commonalities and complementarities between the two research strands, we conducted a systematic literature review. This method yields a more

objective and traceable overview of debates in which research is interdisciplinary, disparate, and where a synthesis of research findings is necessary [39]. We follow the basic analytical steps for the review as laid out by Bryman [40]. Thus, a set of guiding questions structures our review:

1. What are the basic characteristics of the literature on *acceptance* and *legitimacy*?
2. What are the most dominant *objects* of acceptance or legitimacy?
3. Who are the most dominant *evaluators* of acceptance or legitimacy?
4. Which *facets* of acceptance or legitimacy are measured? (Relating to theoretical concepts introduced in Section 2.)

The results for our first guiding question are presented in an integrative manner and with some descriptive statistics; the other three guiding questions are answered by additionally taking into account a smaller set of matching high-quality papers in a narrative and interpretative summary [13,40].

To derive the overall population of to-be-analysed articles, we searched for empirical studies that refer to the concepts of acceptance or legitimacy in their title, abstract, or keywords² and are situated in the broad context of energy or low-carbon innovations³. We used the SCOPUS database, as it contains a comparatively large number of research articles from the social sciences and it is commonly used in literature reviews in energy or sustainability studies [1,41,42].⁴ The search yielded 815 peer-reviewed studies published between January 2002 and April 2022. To screen and select the final sample of papers, we generally followed the PRISMA method [43]. This approach is documented in Figure 1. To ensure a shared understanding and more objective definition of eligibility criteria, a random selection of abstracts and papers were assessed and discussed by multiple authors from the research team at each step.

² This allowed us to limit the results to those articles most likely to have a specific focus on the two concepts.

³ By focusing on low-carbon energy technologies instead of taking a very broad view, e.g. by including all green technologies in our analysis, we can make targeted statements about a more specific and homogenous application area.

⁴ Search string for Acceptance:

TITLE-ABS-KEY (("public acceptanc*" OR "social acceptanc*" OR "local acceptanc*" OR "community acceptanc*" OR "market acceptanc*" OR "socio-political acceptanc*") AND technolog* AND (energy OR "low carbon")) AND PUBYEAR > 2001 AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (LANGUAGE , "English"))

Search strings for Legitimacy:

TITLE-ABS-KEY ("legitim*" AND technolog* AND (energy OR "low carbon")) AND PUBYEAR > 2001 AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (LANGUAGE , "English"))

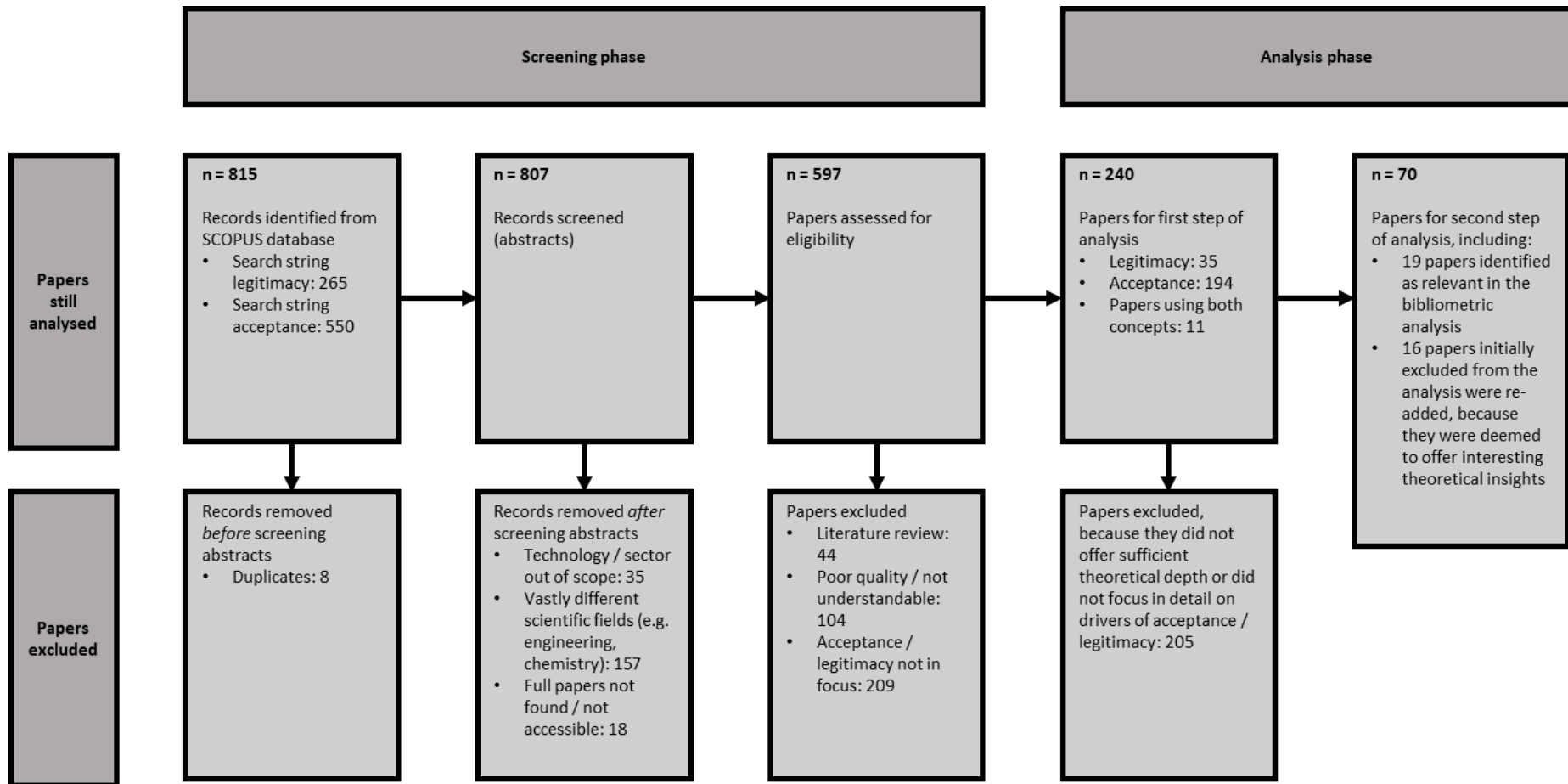


Figure 1: Screening and analysis process (own figure, based on PRISMA reporting method for systematic reviews [43]).

240 full papers were included in our first phase of analysis, of which 194 are acceptance papers, 35 legitimacy papers, and 11 papers integrate both concepts. The higher number of acceptance papers may be explained by the fact that the concept is assumed to be operationalised more easily (quantitatively) than legitimacy. This assumption goes hand in hand with our perception of an increasing demand to consider *social factors* when researching technological developments. This combination of supposedly easier operationalisation and a common requirement by funders to consider social factors could explain the higher number of acceptance papers.

For the 240 full papers in the first analysis phase, we recorded basic information on our guiding questions in a shared worksheet and discussed and iteratively refined the categories and their definition in the research team based on some randomly selected articles. Afterwards, all articles were divided up among the authors and coded individually. Any fringe cases or categories were discussed among at least two co-authors. The set of all coded categories can be found in Table A1.

We also visualised the bibliometric network of these 240 papers as an additional method with the use of the software VOSviewer [44].⁵ This served as a complementary approach to answering our first guiding question. The bibliometric network analysis allowed us to depict and explore the relationship between the acceptance and legitimacy debates. Furthermore, it allowed us to identify *bridging papers* between the two literature strands. Specifically, we analysed bibliographic coupling networks of papers, i.e. the relatedness of papers based on the number of references they share (visualising clusters of papers with similar intellectual roots) [3]. Figure 2 visualises the bibliometric links, with the size of edges weighted according to overall citations emphasising older and more influential papers that already have accumulated multiple citations. The visualisation shows a distinct cluster of articles (in orange) focused on legitimacy and another cluster of articles focused on acceptance (in blue), as well as bridging papers standing in between the two clusters.

⁵ All data used for our analyses in VOSViewer are based on exported data from Web of Science (WOS) and not from SCOPUS (as we did for the scoping literature review), because data exports from SCOPUS were partly not compatible with VOSViewer. However, for those cases that were compatible with SCOPUS data, we carried out visualisations with both SCOPUS and WOS data and found they were very similar. Thus, we used WOS data for our final visualisations.

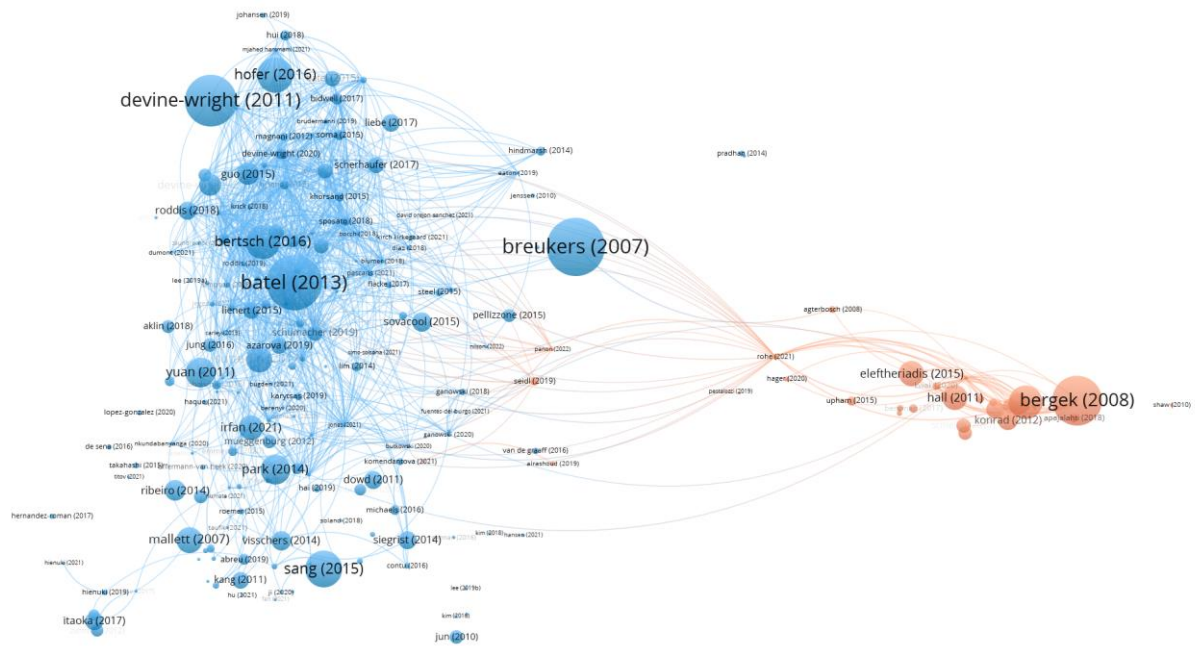


Figure 2: Visualisation of the bibliographic coupling links of 210 of the 240 papers in our database.⁶

For our subsequent qualitative analysis, we collected insights from the papers on common and differing ideas in both research strands and organised them into overarching thematic clusters. The data base for our qualitative analysis consisted of 70 papers, 51 of which we identified in our screening phase as particularly promising for a more detailed qualitative analysis, because of their theoretical depth. Additionally, our qualitative analysis included 19 papers, which we identified as relevant in our visualisation of bibliometric networks. We chose those papers for three reasons: (1) They acted as bridging papers, linking acceptance and legitimacy studies through shared citations, (2) they were cited frequently by both acceptance and legitimacy studies, or (3) they were identified as *cross-cluster articles*. The latter indicates that we categorised them as acceptance or legitimacy articles but in the visualisation of bibliometric networks, they were assigned to the opposite cluster.

3.2. Data base

In this section, we depict basic characteristics of the articles in our final data base. These characteristics are related to guiding question 1 and include information on the journal, the year of publication, the country in focus, the investigated technology and the methods applied. For the analysis of the basic characteristics, we rely on descriptive statistics.

⁶ We had to exclude 30 articles from the visualisation, because the bibliographic data was not available in WoS, or the articles were not connected to any of the other articles in our analysis.

The articles under study were published in a wide variety of journals from different fields. ‘Energy Policy’ (18%) and ‘Energy Research and Social Science’ (13%) are the ones featuring the highest share of articles on acceptance or legitimacy. In terms of the year of publication (see Figure 3), the number of articles on acceptance studies tends to increase between 2013 and 2021, while for articles focusing on legitimacy, we observe no clear trend.

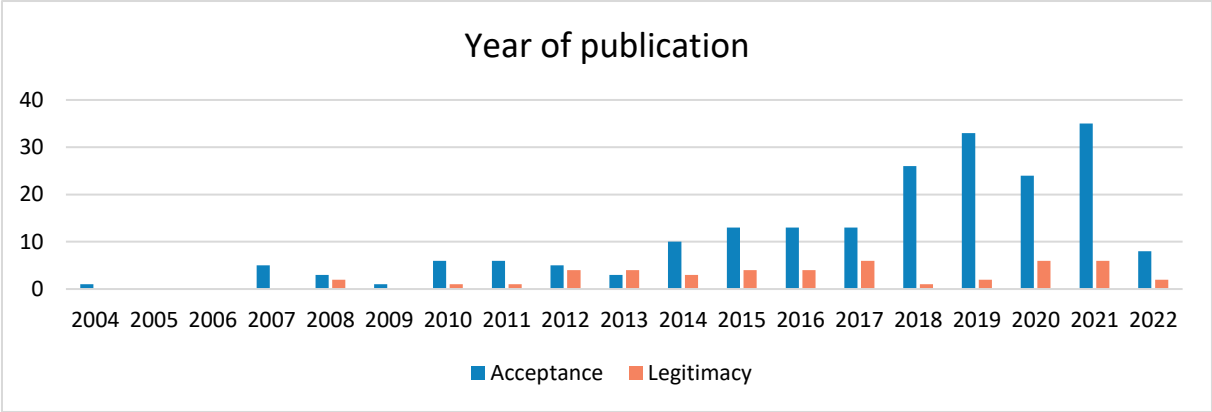


Figure 3: Absolute frequency of the 240 acceptance and legitimacy articles in the final data base by year of publication.⁷

The articles in our dataset do analyse various countries and focus on different technologies. For overview purposes, we defined categories for both and assigned all articles to the respective categories (see Table A1). The majority of countries investigated in the articles in our final dataset (53%) are currently classified as full democracies (see Table 1). Technology-wise, most of the articles in our dataset (61%) focused on Renewable Energy Technologies (RETs) – predominantly wind energy (16%). Further articles focusing on RETs also analysed solar (10%), bio- (8%), water (5%) and geothermal (2%) energy.

⁷ For 2022, the number of articles is lower as we cut off our search in April 2022.

Table 1: Relative frequency of the countries in focus, the investigated technologies and the applied methods in the acceptance and legitimacy studies investigated. Assignment to multiple categories possible.

Categories	Sub-categories	Acceptance (N = 205) ^a	Legitimacy (N = 46) ^a	Total (N = 240) ^a
Country in focus	Full democracy	52% ^b	65% ^b	53% ^b
	Flawed democracy	33% ^b	15% ^b	31% ^b
	Hybrid regime	5% ^b	18% ^b	8% ^b
	Authoritarian regime	10% ^b	3% ^b	9% ^b
Investigated technology	RETs	60%	70%	61%
	Nuclear	7%	4%	7%
	Energy transport, management, efficiency, consumption	24%	13%	22%
	Sustainable fuels	5%	11%	6%
Applied methods	Quantitative	80%	17%	71%
	Qualitative	32%	89%	40%
	Mixed methods	11%	7%	11%
	Accompanying extensive literature review	3%	13%	4%

^a Including 11 papers that integrate both concepts.

^b Due to missing values (resulting from data availability, articles not reporting the countries under study, or articles studying multiple countries from various categories) the sample size is lower for these variables (acceptance: N = 181; legitimacy: N = 40; total: N = 212).

Acceptance and legitimacy studies do differ in the methods that they apply. While the majority of the acceptance studies (80%) apply quantitative methods, qualitative studies are most frequently employed in legitimacy studies (89%). Overall, mixed methods designs were utilised in 11% of the articles.⁸ Finally, some studies accompanied their empirical analysis with an extensive review of the literature on acceptance or legitimacy of low-carbon technologies. This is done by a higher share of legitimacy (13%) compared to acceptance studies (3%).

4. Results

We structure our results based on our guiding questions presented in Section 3.1. In this regard, the guiding questions on the most dominant objects (guiding question 2) and evaluators (guiding question 3) are particularly central, as they point to the relational character of both concepts. This

⁸ Mixed methods were counted not only in the statistics for the mixed methods category, but also for those of the quantitative and the qualitative methods.

means that acceptance and legitimacy are always related to the questions ‘of what?’ (Section 4.1.) and ‘by whom?’ (Section 4.2.). Furthermore, our analysis also shows that for both concepts it is also relevant ‘in relation to which background?’ (Section 4.3.) the evaluation takes place. We refer to this background as the social order and the individual order.

With this tripartite division, we also describe the different levels on which the concepts are observed and researched (guiding question 4) as part of Section 4.1.

4.1. Acceptance and legitimacy of what?

The analysis of acceptance or legitimacy in most cases focuses on a concrete object (guiding question 2), which is examined regarding the acceptance it is given or not, or its (il-)legitimacy. This means that the study of acceptance or legitimacy is always related to the questions of ‘acceptance of what?’ or ‘legitimacy of what?’.

As becomes evident by the quantitative assessment of the research objects in our database, most articles – especially those focusing on acceptance (80%) – do analyse specific technologies (see Figure 4). In comparison, legitimacy studies appear to be rather diverse with respect to the objects of their analysis. While most still focus on specific technologies (41%), a considerable share of articles also analyse innovation systems (35%) or specific actors (13%). When looking at the relationship between the object under study and the applied methods, we find that technologies are less likely to be analysed with qualitative methods.

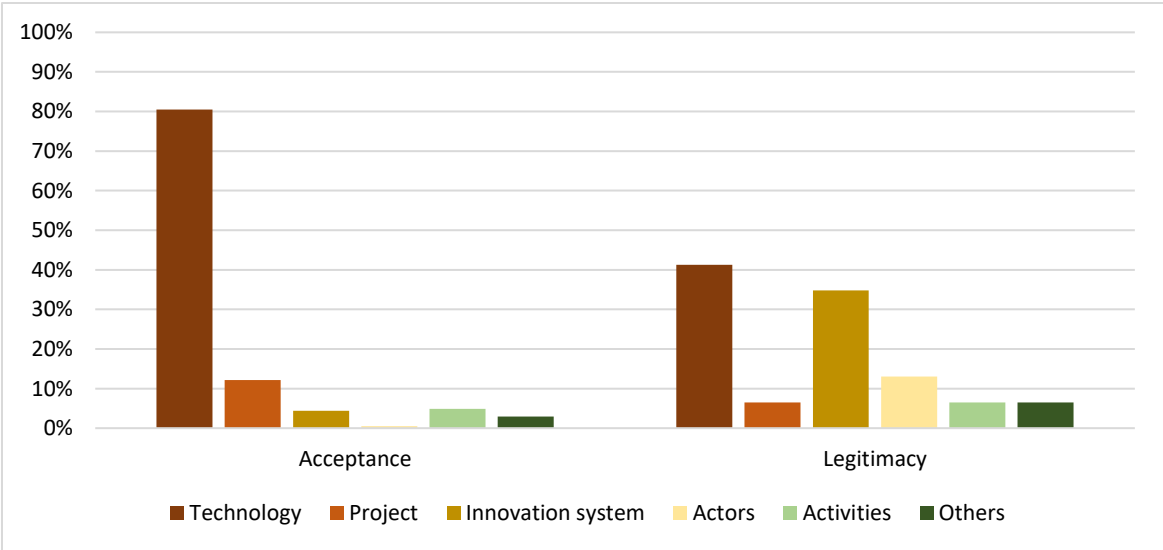


Figure 4: Relative frequency of the objects in the focus of the acceptance (N = 205) and legitimacy (N = 46) studies investigated. Assignment to multiple categories possible.

The objects of acceptance are regularly researched on different societal levels and are thus focusing on different *facets* of acceptance. In our quantitative analysis related to guiding question 4, we

categorised acceptance studies into the specific *facets* or dimensions conceptualised by Wüstenhagen et al. [22]. Additionally, we further applied general categories such as social or public acceptance as well as a global category, to which we assigned all articles that did not analyse specific facets of acceptance, but rather used it without specifying or even without defining it (see Table A1). When comparing the frequencies of the different facets of acceptance and in line with findings by Busse and Siebert [45], it becomes apparent that the rather general categories are applied most often in the analysed articles. Acceptance was conceptualised as social acceptance in 42% of the 205 studies analysing acceptance, as public acceptance in 37%, and a global or undefined category was applied in 30% of the respective studies. Some authors even studied completely different concepts as proxies for social acceptance, e.g. trust or public scepticism in Taufik and Dagevos [46]. Overall, our results mirror the observation by other authors, who identify the acceptance concept to encompass a variety of sub-facets or modes, e.g. awareness, support, adoption, or use, which are all often summarised under the umbrella term acceptance, without clearly distinguishing them [17,47]. In attempts to disentangle the different modes of acceptance, some studies have thus introduced classifications identifying acceptance modes as ranging from a more positive to a more negative valuation and more active and passive levels of action [48].

Among the specific dimensions applied by Wüstenhagen et al. [22], community acceptance was analysed most frequently. It is important to note that the three dimensions of acceptance as proposed by Wüstenhagen et al. [22] interact and influence each other, 'are associated with main actors and are influenced by their interactions and contributing expectations' [49:864]. Thus, a strict differentiation creates an artificial division between them, which has led to them being treated as separate from each other [20,50]. This is especially true when looking at socio-political and community acceptance. While many studies identify a so-called *social gap*, which indicates that acceptance in the socio-political dimension is often not mirrored by a favourable assessment in the community dimension, the socio-political and the community dimension are actually intertwined when looked at relationally [51–53]. The prevalent duality of evaluations between the socio-political and community dimension leads to a neglect of the role that *middle actors*, situated between governmental and societal actors, play in driving (or obstructing) system change, and in diffusing innovative technologies and practices. Thus, research calls for employing a polycentric perspective investigating actors that are working independently of each other across various dimensions across macro, meso and micro levels [54,55]. In general, the interlinkages between the different dimensions are not well understood [56], which is also reflected in the limited number of studies (notable exceptions include [57]) examining multiple dimensions simultaneously.

Turning to the studies concerned with the legitimacy of low-carbon energy technologies, the facets (guiding question 4) analysed in our quantitative assessment are based on the theoretical work of

Suchman [5], who characterises legitimacy in three facets: pragmatic, moral, and (cultural-)cognitive. However, most of the papers reviewed have a rather global or undefined understanding of legitimacy and do not divide the concept into different facets. This is true for 87% of the 46 articles that work with the concept of legitimacy. Few authors, such as Ricard [58] who focuses on input, throughput and output legitimacy (see also [59]), as well as commercial legitimacy, are employing differing facets of legitimacy (see also [60–62] – analysing legitimation, [36] – analysing normative and regulatory legitimacy, and [63] – analysing cultural legitimacy).

Building on Suddaby et al. [13], we further analysed the articles concerned with the legitimacy of low-carbon energy technologies in terms of their understanding of legitimacy. We therefore divided this category into four different subcategories: an understanding of legitimacy as a property, as a process, as a perception, or a different or undefined understanding. Of the 46 articles in our database that research legitimacy, a comparatively high share of articles states to interpret legitimacy as a process (41%), 15% further understand legitimacy as a perception and 7% understand it as a property.

Despite our hypothesis that at the socio-political (macro) level, acceptance is most closely related to the concept of legitimacy, aside from some exceptions (see e.g. [64]), an individual perspective is often being examined ultimately. From a theoretical perspective, it is also important to note that Wüstenhagen et al. [22] also considered the acceptance by key stakeholders and policy actors of effective policies as socio-political acceptance. The existing corpus of literature largely overlooks this particular aspect in their investigations and instead solely analyses the general public. One exception is a study by Devine-Wright et al. [54], in which the role of a diverse set of actors at various levels is taken into account.

4.2. Acceptance and legitimacy by whom?

When studying acceptance and legitimacy, it is important to ask the questions of ‘acceptance by whom?’ or ‘legitimacy by whom?’. These aspects of the concepts of acceptance and legitimacy are reflected in the evaluators (guiding question 3) studied in our database. Evaluators refer to the group of actors (or the overall system) evaluating the acceptance or legitimacy of a specific object (see Figure 5). In our database, the most common type of evaluator – both in terms of absolute and relative frequencies – are (private) individuals (43%). While individuals and households (privately and as market actors) are more common evaluators in acceptance compared to legitimacy studies, it is the other way round for the (institutional) context or society, decision makers, and organisations and firms as market actors. Also perhaps unsurprisingly, we find that studies in which the (institutional) context or the society is the evaluator of acceptance or legitimacy, are less likely to employ quantitative methods. For acceptance studies, we find differences between the dimensions as defined by

Wüstenhagen et al. [22]. While decision makers are most common for community acceptance studies, firms or organisations as market actors are common evaluators in community and market acceptance studies.

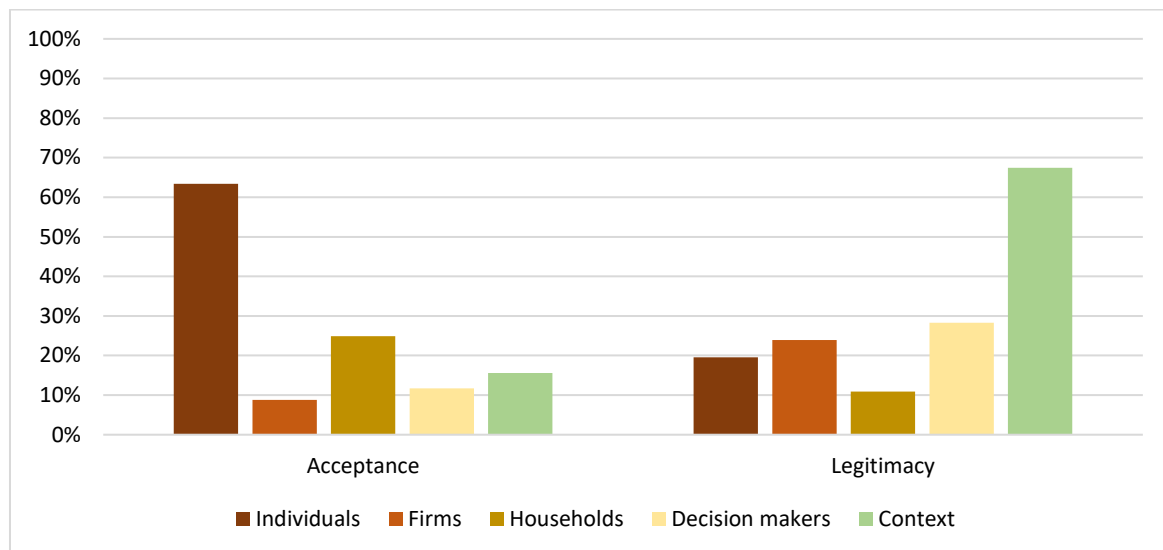


Figure 5: Relative frequency of the evaluators of acceptance (N = 205) and legitimacy (N = 46) in the studies investigated. Assignment to multiple categories possible.

With different actors and evaluators of acceptance being relevant in studies on these concepts, also the understanding of their roles differs. In more recent papers analysed, individuals, who were previously mainly understood as passive respondents or *accepting parties* in acceptance or supporting processes, are now getting frequently involved in participation, governance, and decision-making processes and are understood more as equipped and knowledgeable actors [47,65]. On the local level, this comes with a shift from an understanding of the *community as affected* to a *community of relevance*. Consequently, individual responses are not only understood as *theirs*, rather they are seen as co-constituted in the relation between individuals and other actors [20].

4.3. Acceptance and legitimacy in relation to which background?

As described in Section 2.2., the institutional context is fundamental for the analysis of legitimacy. This is also mirrored by our quantitative findings on the evaluators of legitimacy (see Section 4.2.). In our comparison and analysis of both concepts, we argue that acceptance must also be understood as dependent on some kind of context or order. Therefore, we introduce two terms here: *social order* and *individual order*.

Social order is to be understood as the object-specific institutional framework or background in relation to which legitimacy is evaluated. As the *individual order*, on the other hand, we define the object-specific individual framework or background from which acceptance and non-acceptance

result. Thus, the individual order reflects individual configurations of the relation to an object, e.g. all imprints, experiences, values, traits, and beliefs that shape individuals in their attitudes and behaviour in relation to an object.

The difference in the background against which acceptance and legitimacy evaluations occur is also reflected in the factors explored or identified as being linked to the evaluations of acceptance and legitimacy by the studies in our database. Many factors, which are frequently researched in the empirical literature concerned with the acceptance of low-carbon energy and related technologies, are associated with the perceptions, experiences, values, and beliefs of individuals, whether they are the general public or other stakeholders. These factors include perceived benefits and risks (e.g. [66,67]), knowledge and prior experiences (e.g. [68–70]), as well as affects and emotions towards the respective technologies (e.g. [70,71]). In addition, trust in the involved actors (e.g. [51,72]), the value and belief system of individuals (e.g. [68,73]), and their socio-economic characteristics (e.g. [66,74]) are also commonly researched. Further factors are concerned with the characteristics of the technologies or projects that are evaluated. Here, factors such as the spatial proximity of the (planned) low-carbon energy site to the place of residence of the evaluator (e.g. [69,73]), and the design of the implementation process (e.g. [51,75]) are analysed. Overall, the factors that are commonly researched and consequently often found to be associated with acceptance or non-acceptance predominantly pertain to the micro-level, encompassing a wide range of psychological factors associated with the individual order.

In comparison, the legitimacy studies in our database tend to focus more on meso- and macro-level factors, when researching drivers for the (il-)legitimacy of low-carbon energy technologies. The micro-level drivers associated with the characteristics, attitudes, or behaviours of individuals, however, do not play a predominant role. Factors that are commonly researched, revolve around the role of the (transition) context, societal values and the overall discourse surrounding a technology (e.g. [36,63,76]), sector, or technological innovation system. Further relevant factors for the legitimacy of low-carbon energy technologies are the regional context (e.g. [10,77]) or firm activities (e.g. [78,79]). Finally, similar to acceptance research, the design of the implementation process (e.g. [80,81]) also constitutes a relevant driver in the legitimacy studies in our database. Overall, it becomes apparent that in many studies, legitimacy is not the sole object of investigation. In transition studies in particular, researchers often analyse legitimacy or legitimation processes jointly with other system functions.

5. Framework for understanding the interplay between acceptance and legitimacy

Our analysis confirms that the concepts of acceptance and legitimacy can be seen as interconnected, with both concepts concerned with the overall perceptions of a specific object. Furthermore, both the legitimacy (e.g. [82]) and the acceptance (e.g. [83]) concept are regularly applied in the context of sustainability transitions. Consequently, both are often used synonymously (e.g. [36]). In some studies legitimacy and acceptance are further thought to be related, with Markard et al. [7] identifying socially accepted technologies to possess a high level of legitimacy or Panori et al. [60] arguing that the creation of new paths in energy transitions is more effective if resource formation processes, such as technology legitimation, and social acceptance are aligned. However, within this literature review, we have delineated that the two concepts should not be employed synonymously. While both acceptance and legitimacy are tied to an object which can be considered accepted or not accepted, or legitimate or illegitimate, legitimacy is shaped by institutions and the respective *social order*, and acceptance depends on the *individual order* (e.g. characteristics, experiences, imprints, inclinations, or current circumstances). The differences in the predominant evaluators of acceptance (individuals) and legitimacy (the institutional context) also underline this divide.

To allow for a better understanding of the relationship between the acceptance and the legitimacy concept, we propose the following framework (see Figure 6), which we will refer to throughout the following sections and discuss in the light of the reviewed literature. Figure 6 depicts the social order and thus legitimacy evaluations to both be subject to processes of change through *legitimation* and (de-)institutionalisation processes in general (Section 5.1.). In turn, legitimacy evaluations and the respective social order affect acceptance evaluations and the respective individual order through processes of *socialisation* (Section 5.2.). Finally, acceptance evaluations shape legitimation activities through *agency* (Section 5.3.). Overall, our framework illustrates the circular relationship between the acceptance and the legitimacy concept, with the macro-level evaluation of the legitimacy of an object and the micro-level evaluation of an object's acceptance influencing each other.

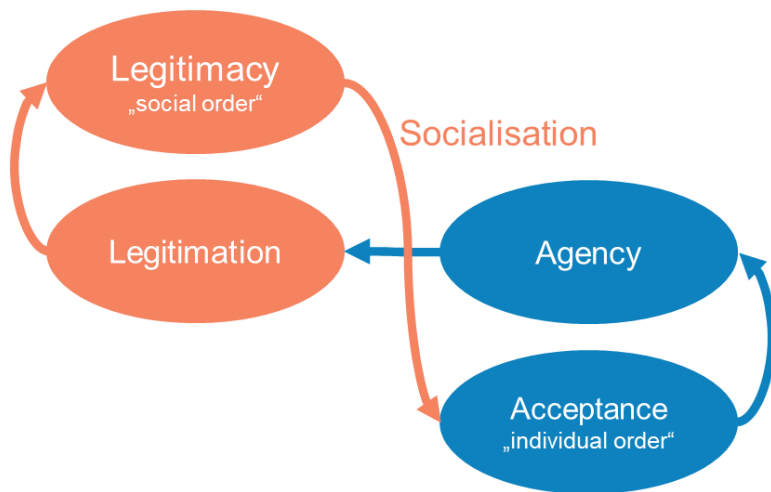


Figure 6: Framework for understanding the interplay between acceptance and legitimacy.

5.1. Legitimation

Although institutions or the social order are understood as highly objectified and stable structures, they are nevertheless subject to change, i.e. processes of (de-)institutionalisation [28,84]. Behind this are various dynamics at different levels of society that unfold their effects over time. A new technology or innovation, which typically suffers from a legitimacy deficit, becomes embedded in rules and routines of politics, policies, and society through so-called socio-political embedding [85,86]. However, it has to be noted that alignment and misalignment with specific institutions can occur simultaneously [36]. This is partly because there is not one institutional framework, but different competing sets of norms or institutional logics [87]. What is considered legitimate in one logic is not necessarily legitimate for all logics. Moreover, institutions are institutionalised to different degrees. An *older* logic may be institutionalised to a higher degree, but an object can still be legitimised against the background of a *newer* logic through negotiation processes. In this regard, rhetorical strategies play a critical role in shaping legitimacy. Incumbent firms, for example, employ rhetorical strategies, which vary depending on whether they are aimed at gaining legitimacy for novel technologies or maintaining legitimacy for conventional ones [86].

Processes of (de-)institutionalisation are thought to be also shaped by the perceptions of legitimacy and practices of legitimation [82]. While legitimacy refers to a status, 'legitimation refers to the socio-political process by which actors shape expectations around the technology' [61:76] and encompasses a set of activities leading to legitimacy [36,60,82]. Through legitimation processes, the development and diffusion of novel or innovative technologies are facilitated [10]. The process of gaining legitimacy involves an interplay between what matters to the organisation and external audiences [82]. Legitimation is a key function within the TIS and its processes can directly impact other system functions, such as the mobilisation of resources, and indirectly contribute to market formation

[7,10,36,61]. Within the TIS, 'the system functions [...] evolve over time. Key functions change, from knowledge creation and legitimation in the initial years to market formation and resource mobilization with the approximation of the growth stage' [61:69].

(De)legitimation processes are often described to originate at the local level and then spread to the broader public. A typical process of legitimacy formation is thought to involve innovation, followed by local validation, diffusion, and general validation [7,10,36]. When looking at the legitimation and diffusion of *spatially sticky* technologies associated with specific locations or regions, the regional context becomes particularly important. Different facets of legitimacy, such as cognitive, moral, and pragmatic, demonstrate varying connections to the regional context [7,10,36]. Overall, it has to be noted that legitimation extends beyond the generation of legitimacy and includes the loss of legitimacy as a relevant research topic. In this sense, legitimacy is an aggregation of aspects, which are more and less legitimate, and destabilisation of regimes is often accompanied by a decrease in legitimacy [7,88].

5.2. Socialisation

Socialisation, as a form of social embedding, is a connecting element between legitimacy and its respective social order and acceptance and its respective individual order, since institutional frameworks are adopted or learnt through socialisation processes. Thus, it may now be considered outdated to believe that actors passively accept or oppose an object. Rather, acceptance must be understood as dynamic and active [47,89]. Although some aspects of the individual order, e.g. fundamental values, are rather stable, other aspects of the individual order are subject to learning processes [49,90], and may be influenced or expanded through processes such as exchange, cooperation, co-creation, persuasion, and conviction. This may ultimately result in the evaluator changing their evaluation of acceptance or non-acceptance.

Common patterns of (non-)acceptance can be understood as supra-individual practices or interests shared by a (coherent) group of actors, and depend on various preferences and institutional settings [49]. Thus, acceptance is a socially constructed outcome and complements existing socio-cultural structures [91]. This way, acceptance is relational, as it is not just conditional on the individual characteristics of the evaluator of acceptance or the features of the object, but also on the context, in which both the individual and the object are embedded. Consequently, it is also dependent on a wider policy context and is evaluated against the background of a whole range of alternative and competing technology options that are currently developed and that the evaluator is aware of [48,52,75].

Contrarily, within legitimacy or institutions is prescribed, what is generally acceptable or not acceptable in a society or social order. In this context, socialisation informs which objects even allow for an individual evaluation. Acceptability, which is sometimes used as a synonym for acceptance (e.g.

[92]), thus stands as a concept between legitimacy and acceptance. While acceptance can be understood as an actual or anticipated behavioural response to a specific object, acceptability refers to a broader, evaluative attitude [93].⁹ Furthermore, acceptability is institutionalised within the context of expectation patterns, determining what is considered legitimate or acceptable. This institutionalisation occurs through socialisation, as individuals *learn* their institutional context [29].

5.3. Agency

Processes of change can be shaped more or less actively. In the course of sustainability transitions, for example, active (strategic) changes are pronounced. Institutions and structures are manipulated so that they correspond to normative goals. The idea of *agency* is particularly relevant here as acceptance (and also legitimacy) is a multi-stakeholder process [21,36,97]. In this regard, other resources, such as money, power, or social position, and competencies for action should be mentioned [98].

Bento and Fontes [61] state that the process of legitimation involves not only compliance with the institutions concerned but also (social) acceptance. Since positions and roles are ultimately fulfilled by individuals within their individual order, their acceptance or non-acceptance influences processes of action and decision-making. This is also true for bottom-up initiatives, which can develop substantial transformative capacity if they are broadly accepted by (local) actors [60]. Consequently, legitimation processes and ultimately the institutional context, and thus the question of legitimacy, can be shaped by the active adoption of agency. Under the term *institutional work*, processes are analysed in which institutional frameworks are actively shaped in order to come closer to specific ideas and goals [99]. Here, opponents and defenders of existing institutions play a critical role in either undermining or cementing these institutions [100]. However, it should be noted that there are no instructions for action prescribed within values and norms on how the value could unfold. Behind every action that is supposed to serve a normative goal, there is ultimately just an assumption or probability that the goal can be achieved through this action.

6. Conclusion and outlook

The juxtaposition of the acceptance and the legitimacy concept has shed light on similarities and differences between the two research strands, their conceptualisations, and their empirical applications. Our findings indicate that the acceptance or legitimacy of low-carbon energy technologies is often analysed without specifying or even without defining the applied concept. Regarding the predominant objects and evaluators of acceptance and legitimacy, as well as the

⁹ It has to be noted, that some authors (e.g. 94–96) offer alternative conceptualisations of acceptance and acceptability.

background, to which they are commonly evaluated, our findings match the expectations and observations voiced in the extant literature. While acceptance studies concerned with low-carbon energy technologies tend to focus on specific technologies and refer to individuals as their primary evaluators, legitimacy studies are more diverse regarding the objects of their analysis. While examinations of legitimacy are also directed at specific technologies, they additionally commonly revolve around entire innovation systems or sectors. Furthermore, legitimacy studies are less frequently focusing on the assessments of individuals. Instead, the institutional context functions as a primary evaluator. Consequently, acceptance and legitimacy assessments are dependent on different kinds of context. While acceptance evaluations are commonly understood as being shaped by the background of an individual in relation to an object (i.e. the individual order), legitimacy evaluations are analysed in relation to an object-specific institutional context (i.e. the social order). To allow for a better understanding of the dynamic interplay between the two concepts, we proposed a framework, which elucidates the critical role that legitimacy and the respective social order play in driving the individual order and thus acceptance, and vice-versa. The bi-directional relationship between macro-level legitimacy evaluations and micro-level acceptance evaluations is mediated through legitimisation and socialisation processes, and agency.

Based on our review of the literature, we provide the following recommendations for future research concerned with the acceptance or legitimacy of low-carbon energy technologies, which might also hold true for acceptance and legitimacy research in other fields. First, similar to Schumacher et al. [69], we suggest that future studies applying these concepts should: (1) state the object and evaluator of acceptance or legitimacy, (2) provide a definition of the applied concept and - if applicable - specify the facet they are examining, and (3) delineate the context or background against which they are relating the measured acceptance or legitimacy evaluations. Second, future acceptance research could delve further into understanding the underlying factors that influence not only acceptance itself but also what we define as the individual order. Consequently, it becomes pertinent for studies concerned with the acceptance of low-carbon energy technologies to focus also on the factors that shape individual beliefs, values, and attitudes, rather than solely on those shaping the perceptions of acceptance directly. Third, empirical legitimacy investigations could also encompass an examination of individuals' acceptance evaluations and their behaviours, as these might affect (de-)institutionalisation and legitimisation processes. Finally, although the concepts of acceptance and legitimacy can be seen as interconnected, the two concepts should not be employed synonymously. Instead, the choice of the concept should be tailored to the specific empirical case and research question.

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Appendix

Table A1: Guiding questions, categories, and definitions for the analysis of the literature.

Guiding question	Categories	Definition for category
1: What are the basic characteristics of the literature on <i>acceptance</i> and <i>legitimacy</i> ?	Journal	Journal in which paper was published
	Year	Year in which paper was published
	Country in focus	Which country or countries does the empirical analysis focus on (classified according to the Democracy Index 2021 ¹⁰ , compiled by the Economist Intelligence Unit (EIU))?
	Investigated technology	Which technology (or sector) does the empirical analysis focus on?
	Applied methods	Which methods are applied? (Qualitative, quantitative, review, mixed methods)
2: What are the most dominant <i>objects</i> of acceptance or legitimacy?	Focal technology	Paper primarily focuses on acceptance or legitimacy of one or more technologies
	A specific project	Paper primarily focuses on acceptance or legitimacy of one or more specific projects
	Innovation system	Paper primarily focuses on acceptance or legitimacy of the overall innovation system or entire technological sector
	Specific actors (or their activities)	Paper primarily focuses on acceptance or legitimacy of one or more actors or their activities and business models in the development and diffusion of technology
3: Who are the most dominant <i>evaluators</i> of acceptance or legitimacy?	Individual citizens	Paper primarily focuses on the individual citizens as evaluators
	Market actors (organisations or firms)	Paper primarily focuses on organisations or firms (as market actors) as evaluators
	Market actors (households or individual end-users)	Paper primarily focuses on households or individual end-users (as market actors) as evaluators

¹⁰ <https://www.eiu.com/n/campaigns/democracy-index-2021/>

Table A1 (continued)

Guiding question	Categories	Definition for category
	Decision makers	Paper primarily focuses on decision makers as evaluators – usually political actors or civil servants who are directly involved in making decisions on state governance
	Institutional context	Paper primarily focuses on the overall institutional context as the evaluator – hence whether norms, assumptions, practices, and beliefs that are shared and established within the broader public and society match the investigated technology
4: Which <i>facets</i> of acceptance or legitimacy are measured?	Facet of acceptance	<ul style="list-style-type: none"> - Specific facet of acceptance is explicitly investigated – socio-political, community, or market acceptance [22] - Paper generally or explicitly investigated <i>social</i> or <i>public</i> acceptance - If paper does not specify acceptance at all, <i>global acceptance</i> is assigned
	Facet of legitimacy	<ul style="list-style-type: none"> - Specific facet of legitimacy is explicitly investigated – pragmatic, moral, cognitive legitimacy [5]. If another specific category is used, this is noted; if no specific legitimacy facet is used, <i>global legitimacy</i> is assigned - Legitimacy is explicitly framed as a property, process, or perception [13]

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