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Social acceptance revisited: gaps, questionable trends, and an auspicious perspective

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ABSTRACT

Recently the field of social acceptance research on energy was mapped by Gaede and Rowlands [1]. Some of their observations are worrying and need reflection. Two essential pivot points have not been recognized, and observed trends in current research practice that must be assessed as highly undesirable are associated with these unnoticed issues.

- Missing in the analysis is the start of social acceptance research in the 1980-ies, when the focus was mainly on acceptance by the public. The conceptualization in three process dimensions, each with different actors and objects of acceptance, reveals that public acceptance can never be a valid proxy for social acceptance. Many researchers continue to maintain this harmful conceptual confusion, and Gaede and Rowland's narrative conclusions seem to suggest we are dealing with a heavy relapse towards public instead of social acceptance.
- The crucial turn in 2000 concerning the object of social acceptance, towards institutional change is also missing. Hence, this recognition of institutions as the core object of acceptance research remains underexposed.

As the interpretation and labelling of most research fronts by Gaede and Rowlands is questionable, an alternative interpretation is paramount. This is done based on a conceptual elaboration, in which social acceptance is recognized as a bundle of dynamic processes instead of a set of actors positions. The object is 'energy innovation', which is also a process. Social acceptance research aims at understanding the transforming social-technological systems, and studies the complex, multi-level and polycentric processes of escaping our institutionally locked-in energy systems.

1. Introduction

Recently, Gaede and Rowlands [1] mapped the interrelations between publications of social acceptance research on energy issues. The transformation of our energy supply systems from the very local to the global level can only take place when crucial actors accept it. These processes revolve around acceptance of the essential elements of those new systems, of the choices needed to bring them about, and of the consequences of the transformation. Gaede and Rowlands (GR) described some conceptual developments, and tried to identify trends that might affect the direction of research in the near future. As such, any researcher of social acceptance should read this paper, as their methodology is illuminating, and the maps reveal some significant phenomena. However, the comments on the state-of-the-art do not go very deeply into the matter and several shortcomings in the field remain unexplored, partly due to some methodological starting points. Hence, although very valuable, this description of the state of the art urgently needs reflection and correction.

My comment starts with some observations on two sources of bias in GR's analysis. The first concerns some important choices and restrictions in the collection of data (Section 2). Second, Sections 2–5 discuss the ambiguities in the understanding of the concept of social acceptance, in GR's analysis as well as in the diverse research fronts they distinguished. Then in Sections 6 and 7 the multi-level and complex character of social acceptance is elaborated in accordance with the well-known three process dimensions (see Fig. 1). As will be explained, social acceptance should be understood as a bundle of processes of decision-making on issues concerning the promotion of – or counteraction against – new phenomena and new elements in the transformation of current energy systems. Combining this conceptualization of social acceptance with some observations resulting from GR's analysis (Section 8), we see several disturbing and dubious trends in the research that need to be discussed and must be challenged. Especially the observed relapse into restrictive, individualistic understandings of social acceptance processes is alarming considering the relevance of social science in transforming the energy domain. In Section 9 a promising

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perspective to escape from the disturbing trends is outlined.

2. Is the field mapped convincingly?

Crucial choices concerning Gaede and Rowland's (GR) method have affected their results. The way they defined the population of publications for sampling, resulted in omission of two important developments. Their maps were based on the oldest citation index, Web of Science, which some still consider as the most prestigious because it is used for calculating journal impact factors. However, the scope of the WoS is limited; its policy of inclusion of journals is not very transparent; and the database is known for its countless systematic errors.[1] The current alternative, Scopus, has a wider scope (particularly concerning social sciences),[2] contains more journals, and its author identification is much more reliable.

When compared to Scopus, the problem with WoS is that many journals are not included, and some very relevant only from a certain date onwards. For example, Journal of Environmental Planning and Management is included starting from 2007 onwards, so the most influential paper by Warren et al. [2] published in this journal is not archived.[3] It coined the 'green-on-green' character of conflicts over wind power, but the paper only appears underestimated (very small) as one of the intellectual foundations in GR's research front 'wind-attitudes-nimby'. WoS has more than doubled its journal coverage during the last decade, so the conclusion that the bulk of the literature (90%) was published between 2006 and 2015 is not wrong, but it is partly an artefact.

More importantly, the take-off of social acceptance research was missed, along with the most significant conceptual turn in the field, about a decade later. From the take-off phase, two lines are still significant for our view today. First, one may argue that the real start of research on social acceptance of energy started with risk perception research, triggered by the contestation of nuclear power worldwide. The first publication in GR's original sample is about this topic [3], but it remained without any impact. Many countries struggled with the huge gap between socio-political acceptance of nuclear power among policymakers and energy companies on the one hand, and low community and general public acceptance, on the other hand. Highly relevant publications by Slovic and Renn [4,5] on risk perceptions and implications for decision-making are absent in GR's search in WoS that was limited to 'acceptance' but they have been crucial for our fundamental knowledge about the complexity of risk management of energy infrastructure.

Second, the stage on social acceptance of renewables was set by publications emerging in the second half of the 1980s, available in Scopus, but not indexed in WoS and absent in GR (their Fig. 1). Currently relevant topics were introduced between 1987 and 1989, mostly in journals that were added to WoS later:

- Pasqualetti and Butler [6] and Wolsink [7] first identified the emergence of land use/landscape issues combined with the actual majority support for wind projects in the community;
- The characteristics of the landscape and proper management of wind farms were recognized as crucial acceptance factors by Thayer and Freeman [8] in a journal indexed by WoS, but not included in GR's sample;
- Identification of community engagement as crucial for establishing wind projects, and the acceptance of household's demand response to wind generated power supply [9];
- The first study based on the developers' common sense view on acceptance (i.e. NIMBY) by Bosley and Bosley [10], and the first challenge of this label as being counterproductive in the same journal in the same journal [11].

3. Social acceptance instead of public acceptance

An important characteristic of the take-off phase was the focus on public perceptions and attitudes. Social acceptance research was initially characterized by its predominant attention on public acceptance, i.e. the aggregated degree of acceptance by individual citizens (attitudes, behaviour, tolerance). Moreover, the distinction between acceptance of technologies and acceptance of projects remained underdeveloped – and, this confusion still persists in many studies. Risk research developed rapidly, also covering risk assessments and risk management, which implies incorporation of risk perceptions in decision-making on project alternatives [5]. This significant move is hardly visible in the GR network, although authors representing this research appear as frequently cited, and this legacy seems particularly reflected in two GR research fronts: 'CCS/perceptions' and 'nuclear/risk values'.

With regard to social acceptance of renewables, GR's results still seem to reflect the question 'Why we still don't understand the social aspects of wind power'. This was phrased by Aitken [12] in an important, but not as prominent identified paper. Following GR's results, indeed she seems to be right in the sense that our existing understanding apparently remains hardly applied. Social research should contribute to debunk widely held, common sense ideas among actors involved in diffusion and implementation of renewables: the technological fix, the one-sided focus on objectors, and the neglect of proactive support [13]. Aitken [12] suggested that much research still uses presumptions that obstruct understanding: opposition to wind power is deviant; opponents are ignorant or misinformed; and the reason for understanding opposition is to overcome it. Such assumptions are closely related to the persistent focus on public acceptance per se and, as Batel [14] observed, on conceptualizing community acceptance as 'communities of the affected' instead of 'communities of relevance'. The GR network also illustrates these two problems. First, the implicit presumption in academic work, that public acceptance would be a valid proxy for social acceptance still lingers. Still, these are used interchangeably [15] thus maintaining great confusion. Unfortunately the misunderstanding acceptance is about impact (affected) instead of all components (communities of relevance) is also reinforced by a conceptual bias in GR's analysis. They focus only two components of the concept, 'acceptance' and 'actors', but not on the 'object' of acceptance.

4. The object of acceptance

In line with psychological definitions for individuals [16] acceptance as an actors position is the degree to which a phenomenon is taken up – liked/disliked, actively supported or resisted, or passively tolerated – by relevant social actors, i.e. the ones who make those choices. When GR discuss the conceptualization of social acceptance (p.143), immediately a crucial difference comes to the fore on a third component, the object: acceptance of what? Whereas they claim to unfold a 'theoretically and methodologically neutral perspective' (p.142), this may apply to their bibliometric centrality metrics and the sophisticated calculation methods; however, choices in the construction of their original dataset reflect a specific view implying a bias concerning the object of acceptance. A remarkable choice was the selection of words to generate the original dataset based on the restriction to 'acceptance' and to the domain of '*energy and fuels*'. GR do not justify this choice, so the 'fuels' element remains unexplained.

Why should fuels, which have been used for a long time and are still dominant [17] define the boundaries of an investigation on social

[1] Citations of Wüstenhagen, first author of the highest cited paper in the field [19] have misspelled author names over hundred times (e.g. Wilstenhagen: 26; Wiistenhagen: 29). Numerous misspelled journal names also exist.

[2] For example, the QS World University Rankings originally used a subset of the WoS. In 2007 it switched to Scopus, with the prime reason of broader journal coverage (QS indicator-citations-per-faculty).

[3] As a result, citations are full of errors; at least six different indications exist.

Table 1
Research fronts (RF): resulting clusters found by Gaede and Rowlands.

RF/ cluster nr.	Label Gaede & Rowlands [1]	Alternative label Reinterpretation of content	Remarkable issues related to the content of major publications in the the RF
1	Wind power/attitude/NIMBY	Analytical reflection on renewables' deployment	Different technologies/Concrete projects/Emphasis on process/Local vs. National/
2	Willingness-to-pay/renewable energy	Framing RES deployment as a market issue	Dominant discipline/Economic paradigm/Focus on public acceptance positions/Less focus on process/Methods driven
3	Households/consumption/ behaviour	Consumers and Households	Main focus on quantity of demand/Consumers other sectors hardly covered/ Recognition demand response for RE and 'prosumers', overlap with RF6
4	Carbon capture/communications/ perceptions	CCS/Continuation of lock-in/trust	Incumbents and authorities struggling with risk perceptions/Technology instead of energy innovation
5	Nuclear/risk/values	Nuclear/risk management/trust	Incumbents and authorities struggling with risk perceptions/Nuclear vs. climate/Values prominent, though equally essential in RF1, RF3, RF4, RF6.
6	Communities/renewable energy/ policy	Institutional change/Socio-technical systems/Community energy	Integration of Renewables/Distributed energy systems/Prosumers/Integration with demand/Intelligent grid/'Energy democracy' concept
7	Hydrogen/vehicles	Hydrogen/vehicles/Distribution infrastructure	Focus on energy carrier/Vehicles also prominent (electric vehicles; V2G) in RF6

acceptance of new practices, ideas, and technologies? Emerging 'new' energy carriers, such as hydrogen, might justify the focus on fuels, but it is more likely that this choice was dictated by the WoS classification system. As a result, the social acceptance network was partly based on a non-innovative domain, whereas many innovative social acceptance studies are covered by other WoS classifications, such as 'environmental studies' (e.g. Land Use Policy; Global Environmental Change) and 'green and sustainable science and technology' (e.g. Journal of Cleaner Production; Sustainability).[4]

Another choice with regard to the object was to follow Upham et al. [18] and to restrict acceptance to technologies. With the introduction of the concept, Wüstenhagen et al. [19] aimed at acceptance of *'renewables' innovation'*, not of only technologies or fuels. Neither should acceptance simply be understood as a position between the presence and absence of a 'social license to operate' an installation [20], which is a restriction to projects. Wüstenhagen et al. [19] was meant to become the conceptual start of phrasing research questions about supposed, observed, or desired social processes. Social acceptance must be understood as a set of activities unfolding over time in complex, multi-layered, polycentric processes that contain countless research questions. This conceptualization has been widely used, also in other domains. For example by Busse and Siebert [21], who emphasized the significance of the object of acceptance in processes of decisions about land use – highly relevant for renewables' innovation – and Wolsink [22] compared socio-political acceptance of infrastructures in the Netherlands in three environmental policy domains: waste, water and renewable energy.

Because of GR's input of search-terminology, the most important conceptual development after the first phase in the 1980s is also partly missing. This significant turn in the field concerns the object of acceptance studies, and it came to the fore in 2000 in three highly cited papers. Many publications analysed by GR refer to these, so they are recognized as intellectual roots, but unfortunately their content has not been used for search terms to construct the original sample. These three publications almost simultaneously pointed at impediments to transforming energy supply that are institutional by nature. The most widespread type of resistance concerns a variety of reasons for key actors (in policy realms as well as among powerful market actors) to avoid setting the proper conditions for enabling the potentially high-level of acceptance in society to materialize. The institutional character of resistance to innovation, the 'carbon-lock-in' as a result of strong and complex path dependency, was established by Gregory Unruh [23] in the most important social science article on energy ever published – in my view. In the second paper, Wolsink [24] identified the significance of the lack of institutional capacity in spatial planning of wind schemes, which is important because space must be considered as the prime scarcity factor for renewables' infrastructure [17]. In the third paper, Jacobsson and Johnson [25] analysed the institutional lock-in for the diffusion of renewable energy technology development, concluding that the required institutional changes are "going to be a slow, painful and highly uncertain process" (p.638).

This crucial turn in the field in 2000 towards the acceptance object of institutional change was largely missing in GR's original sample. 'Institution', 'institutional change', or 'lock-in' were not searched. In fact, GR mentioned institutions only as follows: "Within the citation network, governmental institutions are the most widely cited" (p.146). Beside the, for academic research questionable, tendency observed here, the term 'institutions' is used for government actors instead of the theoretical concept of 'institutions'. In political science, sociology, geography, economics, innovation studies, and in the transitions literature [26,27], the understanding of institutions is based on definitions like this one by North [28, p.5]: patterns of behaviour that reproduce themselves and are structured by formal and informal 'rules of the game'. The energy domain is full of strong institutions [13,22–29].

5. Research fronts

According to GR, a research front consists of a collection of commonly cited, recent articles representing the 'state of the art' thinking in a research field. With their method, basically a sophisticated kind of cluster analysis, they distinguished seven clusters of articles that they identified as 'research fronts (RFs, Table 1). Within each cluster they reported the most important publications (recently highly cited) and the intellectual roots (not part of the cluster, but frequently cited in the cluster). The clusters were described and labelled, but several interpretations poorly cover the content of the RFs.

As the object of institutional change was not recognized by GR, their labels (Table 1, 2nd column) do not refer to this. Institutions can only be recognized by reinterpreting RF6, 'communities/renewable energy/ policy' according to GR. The references observed as intellectual roots of FR6 are primarily the root paper of social acceptance all over [19], Walker et al. [29] recognizing the socio-technical configuration of renewables related to 'trust', and Toke et al.'s international comparison of institutional conditions for wind deployment [30]. Furthermore, papers by Lehmann et al. [31] and Wolsink [32] were identified as 'central', and both are primarily about institutional conditions and application of several technologies integrated with energy demand.

As the interpretation and labelling of most research fronts by GR is questionable, Table 1 shows alternative labels for the RFs, reconsidering their content based on interpretation of the most significant

[4] There is significant overlap. For example, Energy Policy is also covered by 'environmental studies', and Renewable Sustainable Energy Reviews by 'green …technologies'.

publications in each group. RF1, for example, has strongly been misinterpreted by the label 'wind/attitudes/nimby'. Indeed, the majority of papers in RF1 are about wind, but only because this was the first 'new' renewable source that was re-developed, so beside the early studies of nuclear power – still present as RF5 – the first wave of social acceptance studies focused on wind [6–11,24,25]. In the meantime, many studies including the lead paper [19], have also covered other innovative RES, like solar, hydro, biomass and more, and a real research front is studying the acceptance of integrating of different distributed energy system implementing several technologies [32]. A research front should indicate current 'hot' topics, and therefore the GR label for RF1 is misleading. Beside 'wind', the second term 'attitudes' erroneously suggests RF1 primarily deals with public acceptance instead of social acceptance. The latter not only concerns the public, but all relevant actors, and not primarily actor positions, but processes. Third, of course RF1 never had 'NIMBY' as a 'core concept' (p.142), nor has been 'intensely focussed' on it (p.141). The term may be mentioned in several publications, but mostly that was to debunk the validity of this pejorative label. Probably it is not even a concept in the first place, but an institutional frame [13,24,33]. Alternatives were available from the beginning, as illustrated by Vorkinn and Riese [34], identified as an important scientific root paper for FR1. It also it does not study wind power, but hydro, while introducing place attachment as a relevant concept.

As most research fronts could be interpreted differently, based on interpretation of the content of the articles, alternative labels are shown in Table 1 (3rd column). For interpretation, Table 1 also indicates the prominent topics covered by the literature in the clusters that did not come to the fore in GR's labelling. For example, looking at the studies in RF2, the main methods are contingent valuation and conjoint analysis in choice experiments, or simple surveys on preferences [35]. Estimated willingness to pay (WTP) is presented as a proxy for attitudes, so it is mainly about positions, and moreover, focused at the public. GR suggest that RF2 may be primarily methods driven, and mainly oriented around one single discipline, economics. Many valuable economic analyses – available in other fronts – focus on actually relevant market acceptance issues. The claims of WTP studies are usually phrased much wider, even beyond the concept of public acceptance as reflection of social acceptance [36]. The validity of such claims is questionable for several reasons, of which I will only mention the two most important.

The first is that social acceptance, even when measured as a position taken by members of one actor group (e.g. the public), is hardly ever one-dimensional. The conceptual model applied in these studies goes from the requirements of RES to a response in government and law; the latter informs business and policy, and finally through social and commercial marketing, consumers and households "buy RES because they offer value to them" (Stigka, Fig. 1 [36]). However, WTP reflects neither policymaking inputs from stakeholders nor feedback from the market or consumers. Moreover, it does not reflect any acceptance process, and there is no recognition of consumers as citizens engaged – or neglected – in the process of establishing RES infrastructure.

Secondly, the validity of WTP studies is seriously affected by the restraint among respondents to play the WTP game. For example, in a choice experiment Ek and Matti [37] struggled with extremely high proportions of choice sets left unanswered by respondents (49%), concluding that this suggested a protest against the very premise of WTP studies. It seems unreasonable for many individuals to even consider payments to avoid damages caused by a private enterprise. The underlying motives for opting out should be investigated in more depth in future studies. Eventually, what came out as WTP [37] was actually a choice that was made in about 17–18% of the cases. Apparently, many people don't appreciate to be forced into a straitjacket of a fictitious market decisions about renewables' deployment. An important observation, but not a conclusion that is usually drawn in WTP studies.

Whereas WTP studies are of limited value for evaluating social acceptance – or even for public acceptance – the method can still be useful for choices that reflect market acceptance in real-life decisions and that are indeed primarily shaped by individual cost-benefit assessments. A good example is the choice experiment by Kubli et al. [38] for assessing the willingness and flexibility among 'prosumers' (Table 1, see RF3/RF6) to flexibly adapt their consumption in order to enhance the integration of renewable energy in their power supply. Such studies explain market determinants of individual willingness to make real economic choices in favour of the common good. They are more often associated with institutionalized views on demand response – for example 'managed users' versus 'active users' [39] – and how renewables' policy is framing decision of consumers, for example to become prosumers [32,38–40], which is more reflected in RF3 and RF6.

What is most striking in GR's labels is the absence of the second important turn towards institutions as object in social acceptance research. None of the RFs was identified as focusing on institutions, and only one was described as referring to literature with an institutional character, but not recognized as such. This has important consequences for our understanding of the development of the field and our assessment of the trends established by GR. In order to assess these, we have to start with a better elaboration of the concept of social acceptance.

6. Acceptance is a process

The GR network reveals research practices in which social acceptance is often restricted to describing the positions taken by certain actors, often 'the public', and usually as a response to actions and initiatives taken by others [41]. This practice is disappointing, as the original conceptualization by Wüstenhagen et al. intended to look far beyond this restriction: "For all actors in the decision-making process the question of acceptability is at stake" [19; p.2686]. Furthermore, the positions of all actors are explicitly dynamic and continuously being reconsidered and redefined. To study these dynamics, which typically unfold in a 'bundle' of very different processes, three process dimensions were distinguished, leading to a myriad of relevant research topics. The concluding research agenda emphasized that "there is a point for more longitudinal research" [19,p.2690]. Social acceptance is complex and dynamic, as it is a process.

Even the object itself, innovation, is a process. The innovation literature highlights that innovation is neither invention nor diffusion of technology, but rather the development of new ideas materialized in products and services that become accepted in society, replacing other products and practices [26,27]. The process character of social acceptance has been the purport of distinguishing between the three principal dimensions of acceptance: community, market, and socio-political. Because the question of the acceptance object – 'acceptance of what?' –was not adequately addressed by GR, crucial search terms for the social side of innovation were also missing. Innovation concerns transforming socio-technical systems (STS) [13,27], made up of scientific and technological as well as socio-economic, cultural, and organizational components. The domain of social acceptance in energy research should preferably target the transformation of current energy systems into new ones based on renewables.

The character of different simultaneous but interconnected processes is essential, however, current research practice shows great limitations in its recognition [12]. Batel [14] observed that the distinction of three dimensions in research practice has been applied in artificial separations of community members and the public or of the national and the local. Obviously, making such distinctions is crucial in empirical research; however, looking at how this conceptual elaboration has been used in practice, her criticism seems on point. Most articles in the GR network do focus on one element or a set of elements within one of the three categories, sometimes literally, but more often implicitly rendering all other elements 'context'. This often occurs without even defining what kind or what element of social acceptance is investigated, which makes it hardly impossible to analyse the relations of their particular acceptance niche with the other categories.

However, Wüstenhagen et al.'s [19] intention was not factual separation but rather conceptual distinction, 'invented' to help empirical research by understanding and phrasing research questions about the nature and meaning of different paths in overlapping sectors of society in which acceptance processes take place. Methodologically, the empirical relationships between the three dimensions can only be recognized and understood when they are conceptually distinguished. The different processes and their mutual influences are the most essential topics for our social acceptance studies. Exactly with regards these mutual influences, GR show that the research practice is lean, and Aitken's [12] sobering question is still relevant. A researcher who is examining one element of social acceptance is only able to understand the result if there is also an reflection on its interrelation with other processes of social acceptance, including those in the other dimensions. Those relations can generally be characterized as reflecting societal and organizational structures that reproduce general patterns of behaviour, i.e. reflecting institutions [28]. Unfortunately, investigation of the relations between these processes is scarce, but it is plainly alarming that they are missing in some publications GR pushed forward as intellectual roots for the future. I will comment on some of the disturbing trends GR observed, after first redefining the meaning of the social acceptance of renewables' innovation concept.

7. Elaboration of the concept

Right from the start, 'acceptance' was meant to cover all dynamic positions and actions – taking initiatives, early adoption, support, resistance, opposition, apathy, tolerance, uncertainty, indifference – that are relevant for the degree of renewables' innovation, issues previously 'perceived as residual questions simply called non-technical factors' [19; p.2683]. Criticisms of the term 'acceptance', suggesting it would obscure elements like 'resistance', 'support', 'uncertainty', or 'apathy' [18,41], are in fact mainly criticizing current research practice.

Several efforts have been made to further elaborate the concept of social acceptance, all maintaining the three dimensions. There should be full recognition of the essence of the acceptance object – which is anything related to innovation. This has wide implications, such as acceptance of necessary conditions for innovation processes, of conditions needed for implementation, or of the consequences of such implementation [13, p.1786]. This implies acceptance of institutional changes: restructured markets, new taxing systems, education systems, spatial planning processes, energy governance frames, etc. It also involves acceptance of 'creative destruction', like dismantling infrastructures and disempowering currently dominant actors. Other proposed enhancements concern the systematic identification and classification of relevant actor groups in all three dimensions [13;18].

Fundamental propositions concern the definition of the relations between the three process dimensions, which should be understood as multiple layers in a bundle of processes. These layers should neither be interpreted as the size (or scale) of actors, nor as aggregation level of the political process [18] – like 'general', 'local', and 'household' level. Multi-level conceptualization, positioning the three dimensions layered vertically, has been proposed for solar and wind power [42] and for renewables integrated in intelligent microgrids [32]. This way the multi-level character of social acceptance processes is illustrated, emphasizing that conditions set within the socio-political layer (e.g. defining market conditions, or empowerment of local actors) are affecting acceptance processes in the two other layers (Fig. 1). The crucial element of fundamentally re-defining institutional frameworks for decision-making within the levels of market and community acceptance comes to the fore. Processes of institutional change are apparent in all three levels, but formally changing the rules of the game, like redefining the choice sets in markets or effectively empowering citizens for co-production of renewables, is mainly the object of socio-political acceptance [43–46]. It concerns, for example, changing strong legislation favouring centralized power supply over newly emerging, but strongly obstructed initiatives of co-production by prosumers [32,38,40,46,47], which is in fact an overlap of market and community acceptance which is important for renewables (see Fig. 1). In terms of socio-technical systems and transition, it is particularly about how to change regimes structurally, with high resistance among institutional power. According to Geels, such resistance must be associated with policy makers and incumbent firms that "can be conceptualized as often forming a core alliance at the regime level, oriented towards maintaining the status quo."[48, p.26] For example, currently the literature widely agrees about the notion that institutional frameworks generally should foster stakeholder and community engagement (participation, inclusiveness, co-production, empowerment) in concrete projects. Socio-political acceptance mainly concerns such institutional changes rather than a conception that renewables' innovation would call for central direction from above [45,46], but nevertheless the latter still seems to reflect a dominant belief system.

To avoid suggestions that the three levels imply any kind of hierarchy, for example suggested by the criticism that energy infrastructures are being proposed or given by authorities or companies to

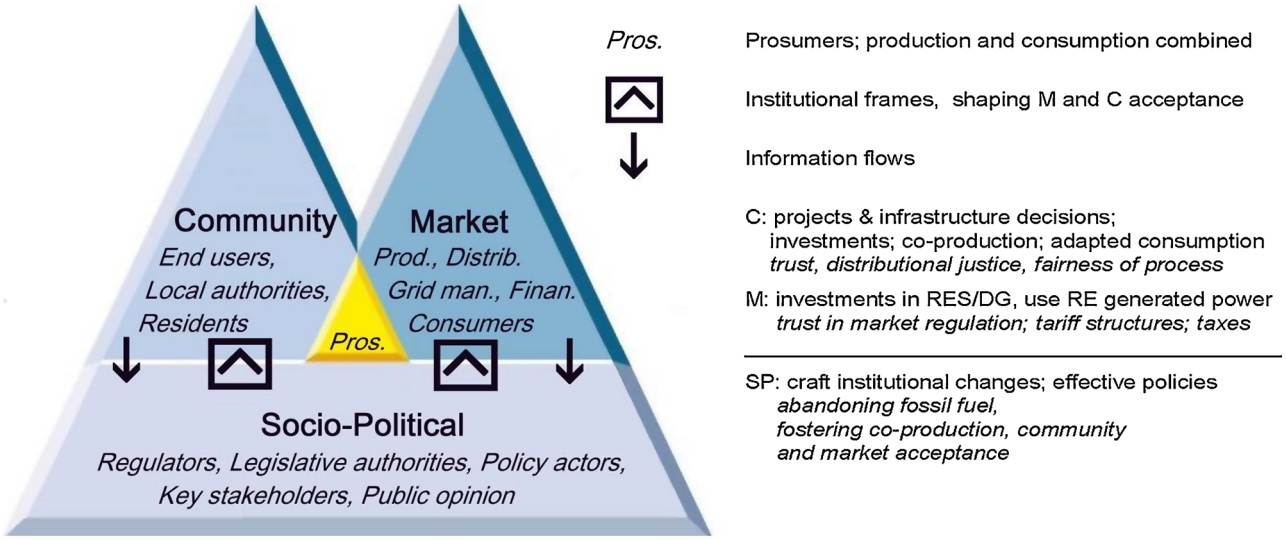

Fig. 1. Wüstenhagen et al.'s [19] three dimensions of social acceptance of renewables' innovation; advanced multi-layered conceptualization for STS based on coproduction [46], with characteristic actors, key objects, and major process influences.

individuals and communities [41], socio-political acceptance should not be positioned on top [42], but it must be considered as a foundation at the bottom (Fig. 1). Disconcerting is that GR observe that the classificatory model [18] is more representative for current research practice, instead of the multi-level approach. It narrows down institutional conditions to 'contexts of acceptance', which is a considerable step backward. It neglects the essence of social acceptance as a bundle of mutually influencing processes.

8. Disturbing trends

GR highlighted a large number of studies that focused on acceptance as mere actor positions, many based on fairly narrow disciplinary designs and mostly one-shot case studies. Often these neither investigate the dynamics of the process, nor do they question the institutionalized patterns of behaviour in those processes. In their own words, they observed an alarming "broad shift in influence from social acceptance as a political issue to social acceptance as a psychological issue"[1;p.153], and "current research is grouped more by technology and intellectual heritage than the kind of acceptance in question" [1,p.154]. For the research field, both observations are highly disturbing. They seem to indicate a return to the public acceptance paradigm of the 1980s and to reflect stagnation in the development towards more integrated questions and move away from focusing on separated technologies and single disciplines.

Disturbing must be considered an understatement; I consider these lethal trends for social acceptance research, and we should wonder why these trends exist. Stern [49] observes that for social science research to be relevant, research topics should have large potential for change in energy terms. Reviewing the significant results from public acceptance studies Rand and Hoen [50] conclude that the implementation of knowledge into practice has been limited. Aren't we conducting research that does not challenge and even reproduces business-as-usual thinking, as observed by Batel [14]? According to GR we do, as they suggest (p.155) Upham's framework [18] is a good representation of current research. However, does this framework provide the necessary focus on the mutual influence of processes in the three dimensions (Fig. 1)? And what about the relapse into public acceptance investigations? Upham et al. [18] write: "the psychological focus on changing attitudes and behaviour through messaging may be viewed by contrast as insufficiently attentive to structural context, but it is not difficult to see why this may be a more attractive option for those responsible for policy budgets in this context." Within one phrase we see several dilemmas for researchers:

- Should we continue research on request of funders, often based on the information 'deficit' model that is known for decades to be invalid for changing environmental behaviour (and not only in the energy domain) [51]?
- Is the attractiveness of options for policymakers a good guide for acceptance research?
- Is the prime focus on psychological factors and functioning processes addressing the major issues of social acceptance of innovation?

My answer to all three questions is 'no'. Only if we turn around the second question the answer could be 'yes'. What are incumbents, including policy-makers [48,52] trying to protect when they opt to implementing evidently ineffective or even counterproductive [53] instruments for messaging and information campaigns? In fact we are faced here with resistance in the socio-political dimension, and social science should resist the shaping of knowledge by incumbent interests [52]. Hence, we also must reconsider the conclusion drawn by GR that RF3 and RF5, both with a strongly single disciplinary character, tend to become the central focus in the field. They identified a pivotal paper by Perlaviciute et al. [54] which distinguished two key components that define evaluations and acceptability of different types of energy alternatives, namely 'general psychological' factors and 'contextual' factors. Psychology is the key domain for finding elements of explanations, whereas context is a set of external conditions, drivers, triggers, and barriers. These contextual factors are defined "as objective characteristics of energy alternatives determined by the context, for example energy price" [54,p.362]. This seems to imply that the social side of the STS character of any energy alternative remains outside consideration. Indeed, these are not included in their conceptual model, so contexts are defined in isolation from wider societal, economic, cultural, and political contexts. The proposed conceptual framework does not assume relations between contextual factors – like 'fair procedures' or 'environmental impact' – and psychological factors – like 'trust' or 'values'. In the article [54,p.362] there is substantial information about interaction effects between the two, but no theoretical recognition about mutual influence. The focus is only on public acceptance at the general and community level, and beside redefining highly politically driven phenomena as market frames, tariff systems, or centralized power supply as 'objective characteristics', it also drastically narrows down the spectrum of these contextual factors, for example, excluding the entire institutional context [54, p.362].

The value – or even the validity – of research aiming at understanding social acceptance of energy innovation under restrictions as described above may be seriously questioned. For example, the dominant approach in consumer choices, as seen in most demand-response studies regarding energy consumption (highly topical for integration of renewables' supply and demand), may be characterized as the "ABC-account of social change" (attitude, behaviour, choice) [55]. This rules out historic path dependencies and does not reveal relevant social practices shaping energy consumption [9,56], and related infrastructures and institutions. Similarly, the way policies try to address the social acceptance of renewables seems equally dependent on this limited vocabulary [55]. As with economic analysis of real market acceptance elements, studying the psychological elements in social acceptance remains valuable, but if it became the main research line and social acceptance of innovation research shifted in this direction, as GR seem to suggest, we are dealing with a heavy relapse. Then the scientific community would find itself again in the pre-2000 research environment.

9. Conclusion: multilevel, polycentric, institutional

The conceptualization of social acceptance of energy innovation revolves around mutually influencing processes at three levels. All involve different actors, who are active at multiple levels. They operate within institutional frameworks, whereas the adaptation of institutions itself is an important object of acceptance. Solid disciplinary theories help to understand specific processes of decision-making or behaviour of special actor groups, but to understand social acceptance we need theories that cover all dimensions and, in particular, address their interconnections. Furthermore, we should recognize that while renewables are abundant natural energy resources (especially solar radiation), their density is relatively low [17]. Scarcity mainly exists because of the amount space needed for energy infrastructure and for 'harvesting' – particularly biofuels are spatially notoriously inefficient [57]. The acceptance of the required land use, weighed against alternative uses [21,46], and the high spatial dispersion of facilities become key issues that are only indirectly addressed in the GR network. Most units of renewable energy generation are relatively small, with high spatial variety and huge geographical dispersion. Decision-making, management and policies become polycentric in nature [32,58,59] an aspect recognized more broadly in climate change mitigation and energy research [60,61].

Some theoretical approaches in the field do cover multiple levels and institutional frameworks, but focus on specific elements of renewables' innovations, for example, risk management [5],

environmental justice [43,62], or equity and justice more broadly [63,64]. However, still most applied theories, as summarized by Busse and Siebert [21, their Table 2] are fundamentally single discipline and focus on a specific layer of social acceptance. There is one exception which can be found in a recent trend in acceptance research, but it has not been recognized by GR. Very promising, founded in several disciplines, such as political science, rational choice (game theory), ecology, anthropology, geography and sociology, and fed by evidence from a large number of empirical studies including natural science data, is common pool resources (CPR) theory, as primarily represented by political scientist and Nobel laureate Lin Ostrom [65,66]. Recently, there is rapidly increasing recognition in social acceptance research of this multi-level theory on sustainable use of natural resources – obviously, renewables are natural resources. It analyses institutional settings that enable optimal management, use and decision-making within social-ecological systems, but also in human-made systems of resource use.

The social-ecological-system focus for renewables has been used by Hodbod and Agder [67]. Most CPR applications, however, concern approaches of power supply as social-technical systems [27]. First introduced by Watson [68] new formats of power supply are increasingly recognized as common pools with high complexity and poly-centricity [59]. With the focus on landscape, these have been described by Wolsink [46] as revolving around coproduction of electricity, coproduction of shared infrastructures, and coproduction in decision-making about land use. In communities of prosumers [32,58,69–72], distributed generation from different variable sources, distributed storage and demand response, are increasingly replacing centralized power supply systems. These distributed energy systems (DES) require co-production based on renewables [40,47,58,68], for example by 'prosumers' (Fig. 1) or any other coproduction scheme, in intelligent micro-grids with peer-to-peer deliverance and accounting [46,69,71,73]. Within CPR, co-production is considered an essential element of any good governance regime [74]. The following factors play a role: the reasons why the resource is scarce, i.e. space [17,46,75]; free or limited access to the system, i.e. equity and justice; and the way in which collective action, coproduction [76] and self-organization [65,77] are promoted, supported or discouraged.

All elements of these complex STSs, at all levels, among all relevant actors, concerning all relevant technologies, and all process dynamics, are the objects of social acceptance. We should recognize that the fundamental challenges of the new intelligent grids – such as the property of the infrastructure, who owns the data within these DES/microgrids, who is in charge of shaping the system, and who is empowered in the process attribution of space for its infrastructure [32,46,78]– go far beyond the interests of the incumbents in the power sector [43,48,52]. CPR theory also provides a comprehensive classification of institutionally defined types of property [79].

Because of its important institutional character, the CPR approach fits primarily to RF6, which I have alternatively labelled 'Institutional change / Socio-technical systems / Community energy'. Because of its integrated character with regard to governance of natural resources, the trend toward this approach will likely accelerate. The most prominent elements of CPR theory are the acceptance of variety and complexity of systems, poly-centricity, multi-level governance, self-governance, adaptive governance, and institutional flexibility. All these elements are important for social acceptance and because of the dynamics they emphasize the process-character and the significance of the mutual connections between all three dimensions of the social acceptance concept: community by definition [47,80,81], market restructuring [38,82], and variety and change in institutional policy frameworks [83–86]. GR's label including community as well as policy already indicates that RF6 has a more fundamental multi-level perspective, but the research in this front is much wider and is likely to merge with the overlapping RF1 and RF3 clusters that focus on co-production and demand response to renewables. It aims to integrate different renewable sources combined with other relevant innovations: community storage [87], demand-response [88], co-production, and prosumers' peer-to-peer supply [73,89], all combined with innovations in governance, property regimes, data ownership, and data management [32,38,40,87,90], and co-production in land use decisions [46,78]. It also recognizes the crucial role of institutions securing fairness of process, distributional justice, and recognition [64,90,91], and supporting trust [4,29]; important factors coming to the fore in all acceptance studies around energy.

GR claimed that their network analysis can "help new researchers become more familiar with the structure of field of knowledge and to identify existing areas of research that are most relevant to addressing the questions and problems they are looking to answer."[1,p.143]. Though some crucial developments are hardly recognized, the first part of this statement can be supported. However, the second claim that the identified existing areas of research are the most relevant for researchers must be firmly contested, and some of the trends observed by GR are doubtful or downright undesirable. The crucial factor that remains obscured is the existence of path-dependent institutional frameworks that reinforce concrete lock-ins that lead to resistance to innovation [23]. The STS of power supply has to escape from the traditional power supply system, that has been identified to undermine the adoption of renewables [48,92] as it is run by "big unwieldy corporate machines" whose change is "characterized by recalcitrance and torpor" [93,p.xx]. With the urgency of providing renewables' based power supply to growing cities [94] with high energy demand and huge competing spatial claims, establishing institutional changes is the most prominent issue in the study of conflicts aboutresistance versus acceptance of renewables' innovation.

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