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Perspective

Social acceptance, lost objects, and obsession with the 'public'—The pressing need for enhanced conceptual and methodological rigor

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ABSTRACT

The cluster-analysis of literature on social acceptance of energy innovation (Gaede and Rowlands, June 2018) necessitated critical comments (Wolsink, December 2018). Their response to my critique rightly points out that the criticism was not just about their questionable selection of literature, but also concerned established tendencies in the literature. The latter asked for a response in which a deepened and more up-to-date definition of the concept of social acceptance was elaborated.

This rebuttal highlights the absence of the *object* of acceptance processes in the original visualization of the literature. Crucial shifts in the object remained completely out of sight. For example, the shift from separate renewable sources towards innovation in which various renewables are integrated – with each other, with technologies of storage, distribution, and demand response. Acceptance processes concern all elements of that integration, in particular the ones obstructed by the institutional lock-in of power supply. The most important objects concern the full transformation of current institutional foundations of power supply – central, uniform, hierarchic – towards foundations based on variety, polycentric management, and self-organization of intelligent distributed energy systems (DES).

Secondly, the conclusions of the visualization were not based on any interpretation about the meaning of keywords used for sampling, only on their frequencies. These conclusions are not 'objective' results, as claimed, but based on applications of wavering and fuzzy conceptualizations in an excess of one-shot single case studies. Nevertheless substantive conclusions about the direction of Social Acceptance research were presented. These proposed directions are worrying, such as the relapse into research of mere acceptance by the public instead of research on all relevant social processes. Social science investigating acceptation processes urgently needs to implement more rigorous and stable methodologies and concepts, preferably applying theories covering all three layers of acceptance processes such as common pool resources theory.

1. Introduction

My main motivation in writing a critique of "Visualizing social acceptance research: A bibliometric review of the social acceptance literature for energy technology and fuels" [1] came from strong doubts about what now has been perfectly summarized in the last remark of Gaede and Rowlands' (GR) response [2]:

> "*Insofar as social acceptance research tends to be concerned with innovation (be it technological or system-wide), and innovation is inherently about change from the present […] the value of academic research for non-academic audiences lies mostly in its practical implications.*"

With the help of their classification, they continue, one can assess how concerns regarding social acceptance (SA) are now firmly 'on the radar'. I strongly doubt whether this is true. Are they really 'on the radar' of 'policymakers, project developers, grant administrators and so forth'? Rand and Hoen [3] showed that the impact of this kind of research on policies in the US remains very limited, and I'm not convinced that the impact is better in other parts of the world. My view is related to the current practice of social science research on energy and particularly the domain of the acceptance of energy innovation. The latter is always about decision-making and often involves conflicts over societal changes. It may be about changes that are being made or about changes that eventually are *not* made; however, as my critique [4] emphasized, the object is *innovation* and, therefore, always about some structural societal change. With this starting point, I don't see a contradiction in the choice to provide knowledge as a 'problem solver' or to provide knowledge based on being 'critical' [2]. As a matter of fact, I see being critical as a precondition for providing solutions, i.e., solutions that

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address societal problems – not solutions for the problems certain actors face – yes, policy makers included – with regard to their own performance and the problems they have with innovation affecting their vested interests.

My substantial criticism [4] concentrated on two essential substantive twists in the field of SA research that were neither observed (a methodological issue: not sampled) nor recognized in the analysis (a matter of inadequate interpretation). Both essential turning points are strongly related to the lock-in elements in the system of energy provision. If SA research does not adequately cover the societal resistance arising from these lock-ins, it will not be relevant. This means, among other things, that the main objects of SA studies are not so much the actor positions for or against a technique or project, but especially the *processes* in which these views for and against new developments come to the fore. And the relevant views concern support for and resistance against the transformation of energy supply systems, the appreciation or rejection of policies that foster and open up opportunities for these transformations, the support for or resistance to all elements of energy innovation more broadly, and above all, the dynamics of all these. Without any doubt, the relevance of GR's exercise [1] is that it contributes to understanding where we are right now, which is necessary to assess how to move forward with SA research. In their response [2], they rightly observed that my main objective is to also contribute to improved understanding, by further refining the definition of SA, both as a concept and as a research programme.

In my critique [4] I raised two main lines. Firstly, the quality of the empirical cluster analysis of the literature, not with regards the application of the techniques and the implementation of the analysis, but especially the substantive choices in the research design. In the second place, and more importantly, I questioned the quality of the narrative conclusions of the analysis – above all on how to proceed with SA research on energy innovation. GR's response to my critique largely focuses on the first aspect, but I think the second line should be weighted much heavier. Hence, I will only briefly comment on a few methodological issues to the extent that they complement the commentary on the second point. It seems more constructive to focus my response on the second issue, as it concerns the broader implications of our discussion for the future study of SA of renewables' innovation.

2. The selection of the literature

The two lines of critique interact where GR's selection process defined the sample and the domain of their study [1], based on questionable choices made in databases and keywords. As it seems that GR have understood that the issue of using Web of Science (WoS) instead of Scopus constituted 'one-half of my larger critique about bias', I have to apologize for being unclear. GR [2] try to summarize my critique in 6 points, and then they conclude that my criticisms revolve around the decision to use only WoS, rather than Scopus. Indeed, I explained why using WoS might not have been a good starting point, but my criticism does not 'revolve around' that choice. Choosing WoS was only the first step. The bias was further strengthened by their research design, which guided the interpretation and the ensuing narrative conclusions. What they missed are two crucial moments in the literature that are substantive: "this is about the take-off of SA research … along with the most significant conceptual turn in the field, about a decade later" [4, p.288].

I questioned the quality of the substantive choices made in defining the body of literature, because I felt that they were motivated by methodologically flawed considerations. The first of several such unfortunate choices concerns the decision to take the WoS coverage and classification for granted. With regard to the objective of GR's investigation, these choices are not convincing, and some of my fears were confirmed. I provided several highly relevant examples of missing articles and journals [4], to accentuate why Web of Science (WoS) was a key factor for the biased results concerning the energy/SA domain. More general evidence that Scopus offers better coverage of social sciences is available for more than a decade [5]. Recently, Harzing, an expert scientometrics researcher and author of scientometric tools, concluded that Scopus provides a broader coverage and better research metrics than WoS in more than 90% of the academic domains – especially in the humanities, but also in the for SA of energy innovation relevant domains of social sciences and engineering [6].

All this, however, is only worth discussing to the extent that it can shape our understanding of the developments in the SA domain, and indeed it does have that impact. To understand SA it is important that in GR's visualization the original recognition of acceptance issues in the energy domain remained completely out of sight. Interestingly, GR [2] now provide the evidence for this exclusion in their own first figure that is revealing that until 2000 WoS did not show any results, whereas Scopus shows substantial results in all years from 1985 to 2000. This underscores the fact that the take-off of SA research on renewables' innovation – contrary to what GR [2] say about it now ('the Scopus database shows a similar "take-off" post-2000′) – did not occur post-2000.

There are two origins of the field in the real take-off in the late 1970-ies and the 1980-ies, not only the one of "the mid-1960s studies of nuclear power" [2; 4th number]. Both are crucial for our current understanding of SA of new energy developments. The first, indeed, is the recognition in the research that there are issues of acceptance related to energy, provisionally not defined as SA. The real start of awareness that SA in the energy domain is a significant issue that should be investigated is obviously associated with the problems around the implementation of nuclear power. The origin of this turn was Chauncey Starr's publication [7] on the acceptability of technological risk. The issue of which technologies would be acceptable to apply in society was prompted by the suddenly emerging acceptance problems related to a technology that was widely considered 'acceptable' at the time. The prime example of this issue was nuclear power. Even though it was accepted and implemented in many countries, it came to be strongly contested, first by doubts raised in the academic community and then by the rapidly evolving public opposition and anti-nuclear movements. According to Starr's 'revealed preference' paradigm, "public safety can be focused upon a tangible quantitative, engineering design objective" [7, p.1237]. This article marked the start of a new domain of risk studies. While nuclear power proved to be an extreme example of contested risk, the general trend in acceptable risk studies soon turned towards the view that acceptance is a social issue – not a technocratic problem – and that the 'revealed preference' paradigm may only be considered an adequate guide to action if one believes that rational decision-making is best performed by experts formalizing past policies as prescriptions for future action [8, p.150].

The object of the studies was soon extended to 'acceptable risk' for future decisions on technologies and projects. As soon as new energy technologies were introduced and promoted, the questions immediately raised were whether society would accept them as such and whether the projects in which they are implemented could be designed in a way that would be deemed socially acceptable. This became the '2nd origin', late 1970s to early 1980s, when SA research on renewables' innovation started with studies on wind power [9–15]. These were also not noted by GR, because of their choice of WoS and their poorly informed choice of keywords. As a consequence, they also missed the original limitation of SA to acceptance among the public and, therefore, could not observe the significant conceptual turn towards the recognition that SA is relevant – often more relevant – among other actors, far beyond merely 'the public'. This turn is already described by Wüstenhagen et al. [16, p. 2,683]. They write that during the 1980s SA was "usually perceived as residual questions, simply called 'non-technical' factors", highlighting that the first time it was analysed explicitly as SA was in the pioneering research of Inga Carlman. She defined the issue as "a matter of public, political, and regulatory acceptance" [13,17]. GR failed to include the very first peer-reviewed paper on acceptance because adding keywords

and abstracts were not yet common practice in many journals at the time. Looking beyond that we see that the paper's research questions make it plainly clear that SA of wind power is being examined [9, p.195]:

(1) "Is incorporation of wind turbines in the living environs accepted?"
(2) "Does decentralized wind energy for homes spur greater involvement with electricity supply?"
(3) "Does this involvement give more opportunities for a more efficient use of wind energy?"

All three questions concern SA topics (e.g. community acceptance and the relevance of engagement of residents in distributed generation). All other SA studies from 1987 to 1989 are also missing, but GR don't seem to find this omission very relevant:

> *[these studies] "may be especially important to some contemporary scholars as a foundational study, the reality is that it just isn't cited by many other current researchers who see themselves as working in this area today*." [2].

However, GR did not find them due to their methodological selection and they were most likely fully unaware of their existence. I'm afraid that many contemporary researchers may also be unaware of these pioneering works, for the same reason. Still, the remark made by GR is incorrect, as Fig. 1 shows the increase over time in citation scores of those 7 articles.

Obviously, the upward trend reflects the rapid growth of research in this domain, but it also shows that currently several researchers know that significant SA knowledge on renewables' innovation already dates from the 1980s [4], p.288]. These studies and descriptions of early SA studies [16] mark three important things:

- The issue was conceptualized as SA before 2007 – at least from 1984 onwards [17];
- SA goes far beyond public acceptance;
- The concept was already being defined during a time period not covered in GR's search.

3. The validity question

Two 'disturbing trends' were observed in my critique [4], and, maybe not on purpose, reinforced GR [1]. The first concerned a worrying confusion of acceptance by one specific actor group, the public, with the layered and complex process of acceptance in society. I was concerned about the effects of the problematic narrative conclusion in GR's network analysis, that there is a trend towards research of public acceptance. My concerns have been confirmed as the visualization study is already used as a reference to support more public acceptance research [18]. Unfortunately, GR did not acknowledge this trend as a shortcoming, but it is actually continuing the field's obsession with 'the public' instead of investigating how acceptance processes in society proceed. They even go so far as to recommend the use of literature that would enhance this relapse to the use of public acceptance as a proxy for SA [4, p.292].

I find the second disturbing trend to be the most important conceptual source of confusion. Because of their reluctance to properly define the acceptance object, GR failed to include terms associated with 'institutions' as the main component of societal resistance created by lock-in phenomena [19] in their search criteria. They claimed not to define the object of acceptance, but they did so implicitly by the choice of keywords of the domains they searched – a methodologically questionable practice. As a methodologist by education, I categorically deny the possible existence of any kind of 'theory-free measurement' [20]. GR claimed they produced

> "*an impartial overview… practically useful for categorizing, reviewing and conducting research on SA…[and because of the]…desire to produce as comprehensive and 'objectivity', neutral (i.e., as objective) an overview of the field as possible, we resisted interpretation of the content as much as was possible*" [2].

In order to achieve validity in any study, the selection of manifest empirically observable phenomena can be based only on substantial criteria that are closely linked to the latent theoretical concepts that they are supposed to reflect. GR explain how they tried to avoid this crucial step [2], and there they confirm my fear that they did not consider 'objects of acceptance' as well as that the inclusion of 'fuels' in their search was only based on the WoS definition of the domain. Here they partly defined the object, without recognizing it. They fully misinterpreted my critique [4] on the application of their selection. I considered the domain too wide, so their search presented in [2] to make it even wider by removing the restriction to 'energy and fuels' is completely irrelevant. Instead I proposed to delineate a more restrictive scope – by defining the research object as 'energy innovation', which would also restrict the term 'fuels' to innovative fuels (e.g., certain biofuels, hydrogen).

For methodological reasons, it is never a good choice to base the sampling on the classification of any system (e.g., WoS), unless it is defined in a way that fits to one's own conceptual framework. GR [1] did not have one, at least not with regards the object of acceptance. The object of the study of SA is about new phenomena, new ideas, policies and projects. The concept of SA is about innovation [16], and, whereas this side of the search should have been more restrictive, the terms used

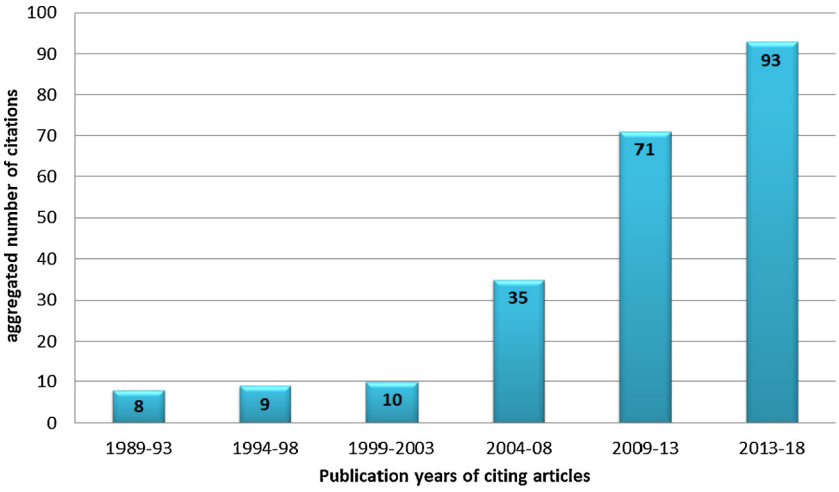

Fig. 1. Citations of the first 7 articles on social acceptance of renewables [9–15] source: Scopus, accessed 9/12/2018.

to find literature covering processes of acceptance were too limited. Examples of keywords that were omitted: 'resistance', 'barriers' (to implementation, deployment, etc.), 'drivers', 'lock-in', 'institution(al change)', '(system) inertia', 'visual (impact)', '(conflicting) land use', 'landscape impact', etc.

The keyword applicable to the quality of results and their meaning is 'validity'. How should we qualify indicators that result in many false-positive results and simultaneously miss many important cases? Unreliable indicators always generate problems with construct validity, the question whether results of an investigation are a realistic representation of reality. This is the problem we face in GR's visualization. Even the wider Scopus search in [2] did not produce many key articles – including the ones indicated in Fig. 1 and [4] that are without any doubt start of SA publications[1] – but also other domains that contain important SA literature on energy innovation. Their Scopus search also shows how many false-positive results are generated when the search domain is neither well-understood nor carefully delineated with narrow and precise keywords.

4. Institutions as the core of SA

The crucial turn towards institutional lock-in as a core object of SA remained hidden, with serious consequences for the sample as well as the interpretation of the results. All articles illustrating this turn [4] were published in 2000, but there are several more. Walker [21] (also published in 2000) is not included in the sample [1], even though it is easy to recognize its significance when reading it. This case study of a nuclear reprocessing plant concluded that embedded commitments can create inertia, allowing inferior technologies and technology paths to persist despite their "*demonstrable inferiority, due to the embedding of various institutional, political and economic commitments, and due to a market structure and state–industry relationship*" [21, p.845].

This classic study illustrates path-dependent lock-in, in which existing hardware and its associated sunk costs create vested interests among incumbent actors. This inertia is not simply caused by physical (objective) or financial (less objective) barriers: the barriers are translated into actor perceptions and framed as arguments supporting the resistance within socio-economic and political struggles around transformations of the power supply system. I'm afraid that many SA researchers are hardly aware of the existence of 'renewable energy denial' as a trend among dominant actors in the struggle to transform the energy system [22]. The argument of 'barriers' is often used in SA processes to frame certain attributes of the implementation of new technologies or projects. It 'objectivizes' an argument that actually reflects subjective resistance to innovation; naturally, this framing is motivated by vested interests. This does not a priori mean that the arguments are invalid, but it is important to recognize that the framing of attributes by any actor as 'barriers' is basically a perception reflecting resistance. Within SA processes many such frames circulate: wind and solar are 'intermittent' sources; residents' disapproval of projects is 'NIMBYism'; the utilities' advanced metering infrastructure (AMI) is 'smart'; distributed energy systems (DES) threaten energy security; etc.

Adequate recognition of framing in acceptance processes requires a thorough framework of interpretation, otherwise it will be overlooked. An example can be found in GR's explorative study of stakeholder views on storage:

> "*Growing interest in energy storage is due both to the range of potential services it can provide to electricity grids as they exist in the present, as well as for its potential role in facilitating a transition to an improved, future grid, particularly regarding concerns about climate change and the need to move toward low-carbon energy systems.*" [23], p.268].

Two contrasting views are distinguished here. Does storage capacity help the existing power supply system and the interests of the incumbents, or does it help accelerate the transformation towards a new power supply system? GR admit that the potential of storage is constrained by institutional and socio-technical system factors. Implicitly they seem to endorse Walker's quote above [21] and my critique that institutions are a root concept, which identifies the societal resistance against energy innovations that originates from system lock-ins [4]: *"storage's potential to provide flexibility is constrained by past and present system arrangements"* [23,p. 267]. This institutional conclusion is derived from the transitions literature, but GR did not recognize the relevant SA acceptance angle of the approach. The omission of SA in the storage study is remarkable, especially as GR [2] now claim that their SA study [1] was an important step towards the storage study. The results were not applied to the storage study [23]; they did not even refer to their SA study.

In summary, despite the numerous articles highlighting the relevance of institutions in SA studies, GR did not include keywords or interpretative understanding with regard to resistance associated with lock-ins. This shortcoming makes the results of their SA study less valid as a starting point for other efforts.

5. Interpretation: a methodological view

My process for creating labels for the 'research fronts' would be considered 'somewhat opaque' [2]. I did not look at metadata, keywords and titles, those may be valuable for a quick scan of the literature – I also use Scopus and WoS for this purpose. However, methodologically speaking, I cannot see any possibility of interpretation in counting keywords or citations. These numbers do not provide proper academic reflection on the content. My critique [4] was primarily motivated by the feeling that I could not fully grasp what kind of SA had actually been mapped by GR. They seem to hold the idea that it is possible to skip interpretation as a crucial step in empirical research, and that this would add to the research's 'objectivity'. I hold a fundamentally different view.

GR provided a sophisticated sort of cluster analysis. Cluster analysis aims at finding different groups among a sample with the objective to interpret what they have in common, i.e., what is unifying the group and what separates individual components. Cluster analysis explores large quantities of data to extract previously unknown, interesting patterns [24]. Assessing what is 'interesting' must be based on substantial criteria other than the input variables, and understanding what is 'unknown' requires good understanding of what is previously 'known'. There are no 'objective' methods of interpretation; conceptual frameworks are a necessity.

I did not claim objectivity, but rather relevance. Beyond keywords and abstracts my 'method' was simple. Over time I have read, analysed, and archived the papers marked as 'pivotal', 'highly cited', or as 'intellectual bases' (and many other papers) in GR's research fronts. Reading core publications does not necessarily aim at designing 'another framework', which GR tried to avoid [2], but it might result in appreciation of existing frameworks and enhance one's understanding of the results from the empirical research that applied these frameworks.

6. Interpretation of 'research fronts'

GR distinguished 7 research fronts (RFs). I have provisionally taken this as valid result, but I recognized in several cases that I interpreted their content differently. The most enigmatic remark in GR's response is that my alternative labels "do not actually appear all that different from ours" [2]. For most research fronts –with the exception of RF7 (hydrogen; vehicles) – I fully disagree with that, and I will illustrate this by

[1] GR did not correct for reduced sample probability, because in the 1980s and 1990s many journals did not yet use abstracts and keywords. Reading these origins of SA research would have helped to better define the domain of research.

Table 1
Research front 1: Comparison of appreciation of content for GR's first cluster [1].

RF1	Interpretation/label 1	Interpretation/label 2	Interpretation/label 3
Gaede & Rowlands	***Wind power***	***Attitudes***	***NIMBY***
Alternative interpretation	***Object: all RES generation:***	***Decision making process***	***Project related factors***
	Wind; Solar; Geothermal (prudent: hydro, bio)	Identification of actors;	Project characteristics (ownership; site; applied RES technology; design)
	Off-shore / marine	Actor preferences;	Place attachment
	Other infrastructure for RES implementation:	Actor interests;	Landscape identity
		Discourses / belief systems	***Affected residents***
	Storage; V2G;	Actor's framing (e.g. 'Visual impact'; 'Barriers'; 'nimby'; 'smart')	'Communities of affected'
	HV transmission;	***Features of process:***	(Distributional) justice [27]
	LV distribution	Justice (procedural/ recognition [27])	Engagement in decisions
	Integration technology:	Fairness of process (perceived)	Participation in project
	Demand Response;	Trust & Reciprocity [25]	Process dynamics
	P2P delivery;	Polycentricity [26]	Multi-layered / multi-scalar
	Intelligent Sensors & control;		
	Distributed ledgers / Internal mutual accounting		

elaborating the differences on the two most important RFs below, based on the framework I have unfolded in my critique [4, Fig.1, Section 7]. This framework combines multi-layered SA processes with common-pool resources theory [25] and it helps to interpret the substance of most research fronts in a fundamentally different way.

The labels of the two most important research fronts are presented in Table 1 (RF1) and Table 2 (RF6). Both already overlap in the analysis by GR ([1], Figure 2), but another strong link is that the prime intellectual root for RF6 is the lead article [16] of RF1. My hypothesis is that these fronts will merge if the starting sample had included the crucial literature on the institutional character of SA. And even more if recent literature is included, particularly on new emerging objects, such as the acceptance of socio-technical systems integrating different distributed generation sources, other technologies supporting distributed renewables, such as demand response, distributed ledger accounting, and distributed storage [26].

Table 1 compares the original labels by GR [1] and my labels with a more detailed inclusion of underlying concepts, and striking differences come to the fore. With regard to the object of acceptance, there is a crucial difference in column 1, where GR say the content of this front is 'wind', but in reality the literature in RF1 goes far beyond 'wind'. Let us look at the origin, and we see this can already be read in the contributions to the 2007 special issue of *Energy Policy* with 12 articles on SA. GR themselves found that the lead paper of the issue was the most prominent in the network, and this introduction by Wüstenhagen et al. [16] discussed many more technology objects than wind, such as PV microgeneration, solar water heating, improved fuelwood cookers, and CCS. Not only these technologies were discussed as objects, but also elements of decision-making (column 2) and characteristics of projects (column 3). The latter objects concern the elements of the process of SA, whereas GR hardly focused on objects of acceptance, but mainly referred to actors' positions with an emphasis on the pubic: attitudes.

The *Energy Policy* special issue also contained several other papers that are prominent in the network – highly cited and roots for later research. These also introduced or discussed fundamental objects in this research front. Two prominent papers conceptualized fairness and justice [28,29], together with [16] mentioned as 'roots' for RF5 about nuclear, risk, and values in [1]), but unfortunately their major issue of "justice" has not been identified. "Justice" is fully absent in all GR-labels, although it has grown into a key issue in SA processes, strongly related to "trust". Justice is only mentioned indirectly in GR's RF1-label in a very strange way. They gave RF1 the label 'NIMBY' and even introduced this as a "core concept". However, in reality this label is in the literature in RF1 debunked as a concept, and it has been repeatedly recognized as a reproachful accusation and tool for discrediting potential opponents. This is in fact more an issue of environmental justice: it reflects a problem of 'recognition' [27]. Such issues concerning environmental justice were discussed in the Energy Policy issue, and moreover, there was also an important contribution trying to find alternative interpretations for NIMBY, such as the notion of place attachment and changing attitudes during the course of projects [29,30]. GR call NIMBY*"a primary factor underlying the 'social gap' between positive general public opinion and negative personal perspectives on specific renewable energy projects"* [1, p.150]. This is a conclusion that can typically only be drawn with keyword counting, without thorough reading. The identification of theNIMBYframe as damaging for acceptance processes has become mainstream [31], but it already dates from the earliest SA studies: "*Case studies have shown that it is dangerous for authorities or utilities to use this acronym, as it tends to offend the public and will generate stronger opposition."* [15, p.205]. I consider the reinforcement of the NIMBY-myth based on only counting how many times the term appears in abstracts, instead of what has been written about it in

Table 2
Research Front 6: Comparison of appreciation of content for GR's 6th cluster [1].

RF6	Interpretation/label 1	Interpretation/label 2	Interpretation/label 3
Gaede & Rowlands	***Communities***	***Renewable energy***	***Policy***
Alternative interpretation	***Prosumers***	***Integration & mirogrids***	***Institutional frameworks***
	Co-production (generation, storage)	DG (distributed generation)	Distributed vs. Centralized
	Community energy	DES (distributed energy systems)	Variety vs. Uniformity
	Citizen's energy	Intelligent grid	Adaptive/Self-governance
	Communities of 'relevance'	Microgrids	Restricting hierarchy
	Cooperation	Demand Response	Facilitating & Opening-up vs. Prescription
	Self-governance [26]	Community Storage	Polycentric governance
	Energy 'democracy'	P2P delivery	Trust; Reciprocity [26]
	Local identity	Place making coproduction	Communities of 'relevance' instead of 'affected'
		Grid balancing storage	

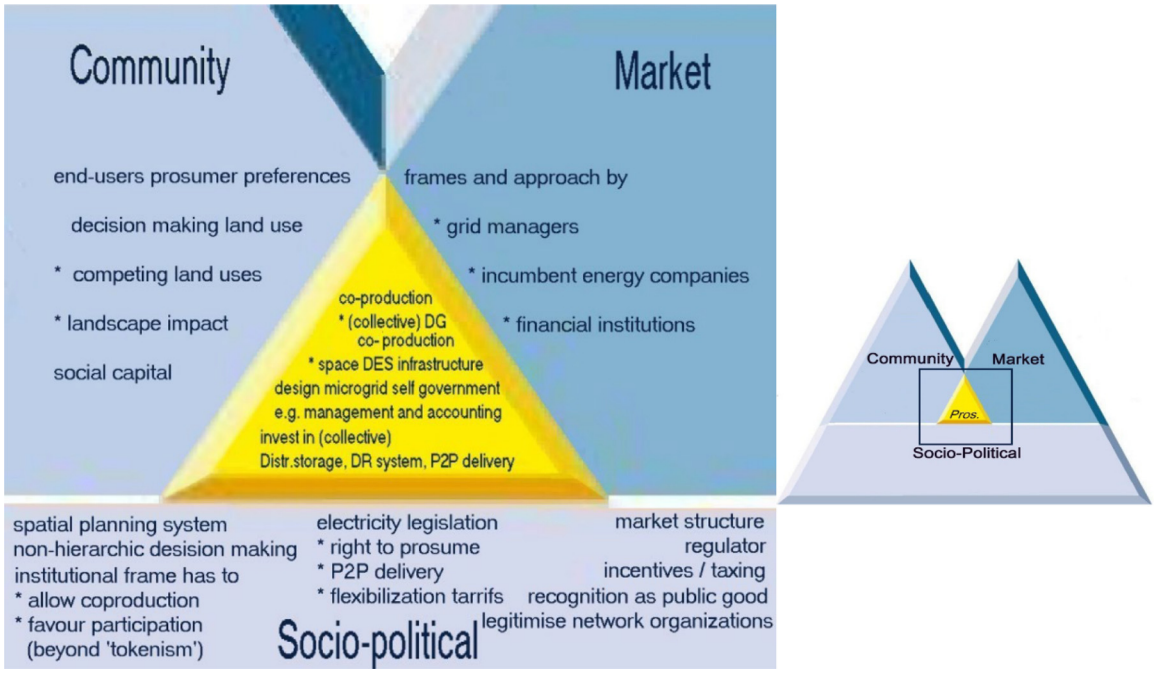

Fig. 2. Social Acceptance of Distributed Energy Systems with 'prosumers' (Left); featured framework from base scheme (right) of the multi-layered SA conceptualization by Wolsink [4], p.291].

the papers, as outright harmful to the progress of understanding of SA in the research field.

The other prominent contributions to the *Energy Policy* special focused on the relation between the multiple layers of SA processes. These were both international comparisons of institutional landscapes for acceptance and cases of wind power implementation [32,33]. Relevant institutional conditions for implementing renewables were introduced, concerning framing conditions for decision-making processes (column 2, Table 1), and now serving in more detail as determinants of RF6 (Table 2). GR's labels of RF6 only refer to 'policy', but there is no recognition that struggles and conflicts around institutional conditions are paramount at the socio-political level. As outlined in [4] institutions have not even been recognized as objects, and in fact they are only briefly mentioned as legal aspects of governments.

As there has been no focus on the object of SA, a significant trend of change in those objects was obscured. Recent contributions to the literature increasingly focus on socio-technical systems that integrate various renewables and demand, a requirement for any future power supply system [34]. The object of SA is shifting towards the acceptance of any condition furthering this integration. For example, significant frontlines in research (Fig. 2) concern acceptance processes among potential 'prosumers' [35–37], emergence of co-production [38–40], and *"citizen-led initiatives which propose collaborative solutions on a local basis to facilitate the development of sustainable energy technologies"* [41, p.136; 42,43]. The institutional frames for the emergence of these phenomena are certainly not 'context', as suggested by GR [4, p.291], but they are significant objects of socio-political and market acceptance processes (Fig. 2). Several conditions set in those layers are shaping the prosumers' manoeuvring space, and often strong resistance comes to the fore. For example, incumbents can 'push back' against distributed generation by restricting DES connections to the network [44].

7. Objects in cutting-edge RF6

The rapidly emerging literature on the objects of RF6 is already much more detailed than the one on renewables and communities. In general terms, rolling out a power supply fully based on renewables is not primarily about acceptance of renewable technologies. Delucchi and Jacobson [34] point at crucial changes in the system, all of which become objects of SA of renewables' innovation.

- The use of intelligent' demand response' [45,46];
- Renewables' integrating environments, introducing application of flexible loads [47];
- Geographical dispersion of naturally variable energy sources [40];
- Interconnection of dispersed sources, physically as well as analytically and in management of supply patterns [47];
- Complementary and non-variable energy sources must be applied to even out temporary gaps between demand and generation [34];
- Introduction of flexible absorption of supply and capacity to upload, i.e., storage capacity at different time scales (hours, day/night, over several days, seasonal) [34,47];
- Storage of electric power at site of generation [48,49], thereby limiting infrastructure impacts on land use [40].

For all elements of interconnection, demand response, utilization of storage, and limiting the need for space, varieties of more localized, self-regulating power supply systems, and optimized DES are needed [36,50].

These objects (Fig. 2) are currently not yet prominent the SA literature, but in other disciplines many studies have analysed community microgrids and the local electricity markets [51,52]. These studies often apply system definitions congruent to common pool resources theory, particularly game theoretical approaches [53–55], but research of acceptance of anything related to distributed generation in microgrids [36] is still scarce. The co-production needed to establish microgrids as well as the enabling institutional frameworks are full of elements that urgently need to be investigated on acceptance issues. For example, generated power or reloaded power from community storage [48–50] can be consumed by others in the microgrid. This is the essential phenomenon of peer-to-peer (P2P) delivery. Generated power or individually stored power can also be consumed P2P, or power might be generated in collectively owned generation units located on the premises of individual prosumers (e.g., rooftops), but this co-produced power can only be consumed directly with P2P delivery. P2P is a highly topical object, which stands in stark contrast to the centralized design

of the current power supply system. This producer–customer paradigm is institutionalized in legislation, company structures, market structures, tariffs, taxes, and hardware (location, design, and ownership of meters, design of LowVoltage distribution). The essential institutional changes required to secure acceptance of P2P delivery as a key element in the development of the renewables in intelligent grids, are key objects in SA of energy innovation (Fig. 2). For example, in most countries P2P electricity transactions are formally not accepted, they are illegal [56][2].

8. Fuzzy concepts or fuzzy research?

Without defining the object of SA, GR have expressed that all literature that identified itself as dealing with social (and public) acceptance was considered SA literature – within their remarkable choice of keywords: *"Far be it for us to argue with authors about whether or not their papers deserve to be included in this amorphous field, nor to add in other terms based on our interpretation of what acceptance entails"* [2]. This is the crucial distinction between their methodical framework and my alternative. In my view, their approach makes all concept development superfluous and meaningless, thereby obstructing progress towards gaining a deeper understanding of SA. In my assessment of the academic exercise, 'fuzzy concepts' are a strong impediment to empirical progress. 'Fuzziness' is inherent to concepts that can be operationalized in more than one manner. Indeed, the domain of SA is based on several concepts with meanings that may be polysemeous, but in order to achieve any practical meaning, we need to squeeze the fuzziness out of concepts as much as possible, instead of continuing with the confusing indifference about the formation of concepts.

The abundance of fuzzy concepts diminishes the practical and policy-relevance of our research. Markusen [57] highlighted this problem for the related domain of urban and regional studies, observing that "fuzzy concepts encourage sloppy and indolent thinking". Any concept needs to be clearly defined, otherwise we cannot empirically confirm its existence and consequently, we cannot understand anything related to its existence. This implies that "resisting the interpretation of the content as much as was possible", as GR expressly claimed [2] to have done, immediately results in inconceivable results as there is no insight whatsoever in the extent to which the use of identical keywords also reflects real similar meanings. As long as SA uses the keyword 'social' acceptance to indicate 'public' acceptance, or 'institutions' as a synonym for organization, we are in trouble. Many more problematic keywords in energy research exist, among those for example 'transition', 'green', 'decentralized', 'smart', or 'visual impact' [40]. My experience in SA research in renewables' innovation strongly reinforces my conviction of the utmost importance of clarity in interpretation.

Aitken's sobering question I mentioned in my critique [4] "Why we still don't understand the social aspects of wind power" [58] must be rephrased, and extended to all renewables and related systems: *Why do we hardly use the knowledge we have on the social aspects of renewables?* This applies to policies [3], but also to science itself. Good research is not particularly about solving someone's problems [2], but it primarily should produce understanding of problems. This is not only by phrasing answers to the research questions, but it has to start with formulating good research questions based on previously generated understanding. The answers may possibly be helpful for solving some problems, but even more important is that good research helps to recognize what our next research questions should be, and understanding why these are important.

I'm worried about the contribution of social science and SA research in enhancing our understanding of what is happening in energy innovation. I'm neither convinced it is "on the radar" [2], nor convinced that the 'energy transition', as proclaimed by many governments, has really taken-off[3]. I do believe that for understanding why the transition has hardly started, and how we can get it started, good social science is crucial. For social science to become relevant [3,59], the minimum requirement is to precisely define and apply the concepts and explain their exact meaning in all our studies. This requires an a priori understanding of the domain of SA, including its objects, and application of congruent frameworks for the interpretation of results. The SA domain also suffers from an overload of single, one-shot case studies. Deepening the external validity of our studies requires replicability [60, p.44 and 138], which starts with setting clear, comparable definitions of all key-concepts. Whereas replicability of research results and the robustness of meta-analysis in disciplines like psychology and medicine has demonstrated sobering results [61], my hypothesis is that carrying out a real meta-analysis on SA would not even be possible. As long as we do not apply our concepts in a consistent way and implement more conceptual rigor, we will stray further away from real understanding, and practical relevance will remain problematic.

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