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Stakeholder Involvement in Sustainability Science - A critical View

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Abstract

Discussions about the opening of science to society have led to several developments: New fields of sustainability science and transformative research have emerged and the "megatrend" of stakeholder participation has reached the academic world and thus research processes. This challenges the way science is conducted and the tools, methods and theories perceived appropriate. Although researchers integrate stakeholders, the scientific community still lacks comprehensive theoretical analysis of the practical processes behind it – for example what kind of perceptions scientists have about their role, their objectives, the knowledge to gather, the understanding of science or the science-policy interface. Our paper addresses this research gap by using the categories above to develop four ideal types of stakeholder involvement in science – the technocratic, functionalist, neoliberal, rational and democratic type. In applying the typology which is based on literature review, interviews and practical experience, we identify and discuss three major criticisms raised towards stakeholder involvement in science: the legitimacy of stakeholder claims, the question whether bargaining or deliberation are part of the stakeholder process and the question of the autonomy of science. Thus, the typology helps scientists to better understand the major critical questions that stakeholder involvement raises and enables them to position themselves.

Keywords: Stakeholder involvement, sustainability science, legitimacy of science, typology.

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1. Stakeholder involvement in Sustainability Science

The involvement of stakeholders into science is an expanding trend in an increasing number of research areas, especially in those that besides their technological dimension also touch societal, economic and political interests[8]. Due to the complexity of such fields like i.e. the energy transition[9], the scientific community felt the need to go beyond conventional scientific methods by incorporating non-academic actors´ views and knowledge in their research through stakeholder involvement[10]. The concept that is common in the economic realm (mainly to deal with Corporate Social Responsibility strategies) or the political realm (i.e. in decision-making processes) has thus been integrated into the broader science environment and especially into new scientific fields such as sustainability science (Kates et al. 2001; Clark and Dickson 2003; Komiyama and Takeuchi 2006; Jäger 2009; Ostrom 2009; Jerneck et al. 2011; Wiek et al. 2011), transformative research[11] (Schneidewind and Singer-Brodowski 2013; WBGU 2011; Dietz and Rogers 2012; Crocket et al. 2013) and transition research (e.g. Kemp and Rotmans 2009; Geels 2002, 2011; Loorbach 2007; Markard et al. 2012). These new fields incorporate a broad array of concepts like post-normal-science (Funtowicz and Ravetz 1993), mode-2 science (Gibbons et al. 1994), mode-3 science (Schneidewind and Singer-Brodowski 2013) or citizen science (Irwin 1995; Fischer 1996) as well as transdisciplinary (Hirsch Hadorn et al. 2006; Berger 2010; Daschkeit 1996; Scholz 2000; Bergmann and Schramm 2008; Jahn 2008; Nowotny 1997) and participatory research strategies (Kasemir et al. 2003a, 2003; Becker 2006; Robinson and Tansey 2006; Scholz et al. 2006; Glicken 2000; Renn et al. 1991)[12].

In this context, the main objective of stakeholder involvement is to tackle the "complexity, uncertainty, and multiplicity of values" and perceptions on controversial issues such as the energy transition, or mitigation and adaptation to climate change by combining "expert assessments with problem framings of the lay public" (Kasemir et al. 2000: 181). Lang et al. (2012) refer to objectives of stakeholder involvement by saying that sustainability issues need "the constructive input from various communities of knowledge" – here described as scientists from different disciplines and non-academic-actors – to include "essential knowledge from all relevant disciplines and actor groups related to the problem" as well as allowing for the incorporation of "goals, norms, and visions". Particularly the

[8] Schneidewind (2013: 83) defines the integration of the technological, cultural, economic and institutional dimension in transformative research as „transformative literacy".

[9] The energy transition refers to the task of decarbonizing the economy and shifting from fossil to renewable energy sources.

[10] There is a variety of terms used, ranging from stakeholder dialogues over stakeholder participation and stakeholder engagement to stakeholder involvement, depending on the scientific field and the research context.

[11] WBGU defines transformation research as the analysis of the transformation process and transformative research as the one supporting the transformation process (WBGU 2011: 23).

[12] The movement of action research also belongs to these new research strategies (Action Research Manifesto 2011).

involvement of citizens is linked to discussions on challenging existing epistemologies of science and assessment of knowledge production and knowledge validity (Tàbara 2013: 116). Welp et al. (2006) describe stakeholder involvement in science as the "structured communication processes linking scientists with societal actors such as representatives of companies, NGOs, governments and the wider public", called "science-based stakeholder dialogues" 13. A more pragmatic branch of stakeholder participation engages with the development and implementation of methods and participatory tools intended to support sustainability learning and the transformation of agents through "effective interfaces between knowledge and action" (Heras and Tàbara 2014: 379; Cornell et al.: 64).

This implies that transformative research does not focus on "intrinsic" scientific discussions, but on solving "extrinsic" societal problems (Strohschneider 2014: 180). Weingart and Maasen speak of a "democratisation of expertise" (2005) whereas Gibbons (2000: 162), Nowotny (2003) and Nowotny et al. (2001) call for the creation of "socially robust knowledge" through combining research capabilities with other institutions, actors and practices which are relevant for the transition to take place. Schneidewind et al. (2011: 134) add that to generate system, target and transformation knowledge in transformative science, the latter has to integrate "context- and experience knowledge of relevant actors". Hayn et al. (2003) organize stakeholder input on three different levels: on the analytical level, stakeholders bring in system knowledge through their practical experience; on a normative level they add orientation knowledge through their opinions; and at the operative level they incorporate target knowledge and transformation knowledge by working on solutions with their own set of resources and motivations. Glicken (1999) divides knowledge into three types: "cognitive, experiential, and value-based", where cognitive knowledge stems from technical experts, experiential knowledge comes from people sharing their personal experience and value-based knowledge is related to social interests and social values.

Academic literature describes a wide array of opportunities associated with stakeholder involvement – although mostly related to participatory and decision-making processes concerning for example the implementation of GHG mitigation measures (Kempton 1991; Löfstedt 1992), global processes of change (Shackley and Skodvin 1995) or environmental governance (Renn et al. 1991; Renn and Schweizer 2009; Bäckstrand 2006). Stakeholder involvement is said to increase relevance (Spangenberg 2011: 283; Hirsch Hadorn et al. 2006: 125; Baumgärtner et al. 2008: 387), legitimacy and credibility (Fiorino 1990: 228; Cash et al. 2003: 8087; Spangenberg 2011: 283), ownership (Lang et al. (2012); Spangenberg 2011: 283; Bäckstrand 2006: 472), effectiveness (Funtowicz and Ravetz 1993: 755) as well as the (social) accountability of research (Welp et al. 2006:171; Gibbons et al. 1994: 3; Bäckstrand 2006: 484ff; Lang et al.(2012); Kasemir et al. 2000: 182)

[13] A science-based stakeholder dialogue needs to be designed in an open manner such that stakeholders are able to communicate their values and the constraints and boundary conditions that they feel limit their freedom to act (Kasemir et al. 2000: 181).

However, criticism can also be found in the literature; mostly concerning the validity and credibility of scientific results established with stakeholder involvement (Yosie and Herbst 1998: 4). Concerns relate to co-design – the involvement of stakeholders in the definition of research questions and designs (Schneidewind and Singer-Brodowski 2013: 121ff) – and the co-generation or co-production of knowledge – i.e. the integration of societal actors' bodies of knowledge into the actual research process and related scientific findings – (Schneidewind and Singer-Brodowski 2013: 316; Pohl et al. 2010: 269). Pohl et al (2010: 271-272) identify three major challenges of this co-production of knowledge: the challenge of power, the challenge of integration and the challenge of sustainability. Related to this, some fear that certain kinds of stakeholder involvement might as well threaten the autonomy of science (Strohschneider 2014; Bosch et al. 2001: 201; Enserink et al. 2013: 14). Brandt et al. 2013: 7), who define five challenges[14] of transdisciplinary research projects, criticize that currently there is "no clear set of tools required for different process phases or integration of different types of knowledge" as well as little "practitioner empowerment".

Since participatory or decision-making processes – i.e. labelled as "policy dialogues" by Welp et al. 2006: 172f) – typically do not concentrate on the generation of knowledge, we explicitly do not follow these concepts in this article.[15] We instead follow the distinction between research processes that aim at improving knowledge and evidence and decision-making or management processes as proposed by Mackinson et al. (2011: 19). While we relate to the approach of Renn and Schweizer, who developed six concepts of stakeholder and public involvement in risk governance based on "philosophies of participation and collective decision making" (2009: 176ff), we in contrast look at the way stakeholder dialogues between science and society are understood by scientists. This perspective that we find important for carrying out scientific work with stakeholders is so far underrepresented in the peer-reviewed literature.

In this paper, we establish a typology of scientific perspectives on stakeholder involvement. Section 2 will briefly outline the methodology behind the typology and section 3 will describe the different ideal types we derive. Section 4 shows an example by applying the typology to the field of energy transition research. In section 5, we use our typology to analyze and systematize the critique with regards to stakeholder involvement by deriving three continua that enable scientists to position themselves (section 5). We conclude by pointing out the critical choices for scientists that arise from this analysis (section 6).

[14] Three of the challenges that were evaluated via an analysis of case studies relate to the discussion in this paper: "research process and knowledge production; practitioner involvement; generating impact" (Brandt et al. 2013: 2ff).

[15] Welp et al (2006) differentiate policy dialogues, multi-stakeholder dialogues for governance, science-based stakeholder dialogues and corporate dialogues based on their objectives.

2. Methodology

Depending on the perspective one takes, stakeholder involvement practices and the difficulties and critical choices they entail, differ substantially. In order to show this, we establish a typology of ideal types of scientific perspectives on stakeholder involvement. Though in practice there might only be hybrid forms, the development of ideal types has a long tradition in sociological studies as a research heuristic that stresses and exaggerates distinctive characteristics of a group of cases to disentangle different categories from each other (Kelle and Kluge 2010: 83).

In order to develop our types of stakeholder involvement in science, we apply five criteria of differentiation:

1. Role of the scientist: The perception on which role the scientist should take (and in relation to that also the stakeholder) differs widely. This also relates to the question of the autonomy of science (see for example Welp 2006: 180).
2. Objectives: The reasons why a scientist would want to work with stakeholders are diverse – ranging from increasing impact on real world issues to getting insider information or increasing legitimacy (see for example Renn and Schweizer 2009: 176).
3. Kind of knowledge: Scientists seek to gather different kinds of knowledge when involving stakeholders. Based on other differentiations such as cognitive, experimental and political knowledge (Glicken 1999: 301f) or system, orientation as well as target and transformation knowledge (Schneidewind and Singer-Brodowski 2013: 42ff, 69ff), we structure the kinds of knowledge that scientists can integrate into their research along the range of pure data, information, assessments and normative values.
4. Understanding of science: Scientists have different understandings of good or appropriate science including not only tools and methods, but also epistemic and philosophical questions (Weingart 2003: 53ff). Is science a detached system dealing with self-referential questions or does science serve societal needs? Can science be neutral and objective or does it mirror societal developments and conflicts?
5. Science-policy interface: The role and impact scientists have or expect to have on political decision-making, and hence their perceptions of the societal responsibility of science, strongly imply the way stakeholders are involved in the research process.

On the basis of these criteria, we derive our typology from literature and own experiences working with stakeholder dialogues in climate and energy transition research. We complement both with empirical data generated in interviews with practitioners that involve stakeholders in their research projects , focusing on their perceptions of the science-stakeholder relation and practical experiences[16].

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[16] All authors are active or have recently been active in projects involving stakeholders. The typology is based on experiences e.g. from the following projects: "Investment Impulse for the German Energy Transition in Times of Economic and Financial Crises", funded by the Federal Ministry of Education and Research (BMBF),

3. A stakeholder involvement typology for scientists

Sections 3.1 to 3.4 describe the four ideal types – the technocratic, the functionalist, the neo-liberal and the democratic type – of stakeholder involvement in science. Section 4 makes use of a hypothetical scenario from the Energy Transition in Germany to illustratively discuss the different types that we here deal with.

3.1 Technocratic type

The technocratic type's main objective to get stakeholders involved is to improve the scientific research process by broadening the extent of available information through the engagement of what could be called 'expert-stakeholders' (Gupta et al. 2012; Whitmarsh et al. 2007: 5). The role of stakeholders is to provide issue-specific, objective and falsifiable information that fits into the classical way science is conducted according to philosophers of science such as Karl Popper (1957). Thus, the technocratic view shares certain important characteristics with the literature on expert interviews (Przyborski 2014: 118ff.). If lay people are involved in research processes it is only indirectly as a source of data (Fiorino 1989: 293f). They do not provide information themselves - e.g. the interpretation of these data - but lend it to scientists who use it to extract what they consider is relevant for their research (Fiorino 1989: 298f, 1990:227).

The impact of stakeholders on science is thus relatively limited in the sense that stakeholder involvement is expected to feed in additional data and information, but not to define or transform the research question or process. The ontological difference between scientists that play the active part in research, and relatively passive stakeholders involved directly, if experts, or indirectly if lay people, is greatest in this view. Scientists determine all the elements of the research process autonomously, including the ways in which stakeholders are involved. Consequently, the scientific sovereignty of interpretation, or primacy of science, is kept throughout the research process.

The kind of knowledge that is to be generated by stakeholder involvement is defined from a purely scientific angle and thus, research questions are derived from intra-scientific debates and controversies rather than societal needs. Consequently, research questions typically focus on the technological dimension of transformation processes rather than on cultural or institutional problems, which are more closely linked to research on implementation (Schneidewind 2013: 83ff). Stakeholders are involved only on an analytical level, providing data and information rather than assessments and normative evaluations. Moreover, since technocratic research is

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often based on a linear concept of knowledge transfer (Bergmann 2014), it tends to neglect questions of implementation and societal impact like the social robustness of the knowledge it generates. Such a relatively narrow concept of scientifically relevant knowledge is in part due to the understanding of the science–policy interface put forward by the technocratic type. In discussions on scientific consultation in policy or decision-making processes, it is often circumscribed by the idea of ‚speaking truth to power‘ (Pohl and Stoll-Kleemann 2007: 10f) and emphasizes ethical neutrality and technical advice. Science and policy-making are conceived of as separate fields that are not intertwined. Rather, scientific findings are expected to inform policy processes and provide the foundation for policy measures. How these findings can become relevant in the sphere of politics is, however, not discussed in this context. From a technocratic perspective, this is a question that is to be addressed by politicians or activists, but of no immediate interest to science.

3.2 Neoliberal type

The neoliberal type understands knowledge as “merely a ‘hook’ on which interests hang their case” (Radaelli 1995: 173). He acknowledges the existence of interest and power in the science society interfaces and understands stakeholder participation as a tool for both groups to impose their perceptions and interests, or parts of them, on the other group. Stakeholders are thus understood as lobby groups or individuals advocating for their specific organizational, individual or political interests and try to channel their views into the research process and thus indirectly into a public discourse or the political arena. Furthermore, stakeholders are interested to get legitimacy of certain positions by the “objectivity” often claimed by or attached to scientists (van den Daele 1996: 297ff). On the other hand, scientists are not understood as “naive”, but conscious about the differing interests and are able to only take out the knowledge/information they find valid or interesting (Hoppe 2005: 210). Following this understanding, stakeholder involvement would be a tool for scientists to efficiently obtain data or knowledge they need for further research. Stakeholders and scientists are both aware of these mechanisms and try to use them for their own purposes. Scientists might even want to use the process as a means to channel their research results into actual projects and decisions to ensure impact or application of the research. Another motivation for the neoliberal type of scientist to involve stakeholders is the perception of an increased chance of being funded by public authorities that support stakeholder involvement (Schneidewind 2013: 178).

The kind of knowledge scientists try to get from stakeholder involvement depends on the specific discipline, task and methods applied. Knowledge is not bound to pure data or information but can also include system, normative and creation knowledge. The phase where stakeholders are involved is not restricted. They might already be part of the negotiating phase between funding partner and scientists. The science policy interface is thus seen as a kind of “battlefield” where both groups follow their specific interests and bargain about all possible aspects, i.e defining the research question, methods, wording, boundary conditions for modelling exercises, scenarios, possible take-outs, messages and interpretation of the results and communication. The actual roles of scientists and stakeholders and their respective influence on the research process are not pre-defined in the neoliberal "bargaining" concept of stakeholder involvement. Although scientists are expected to have a slightly greater impact on the research process, no ontological difference between the two groups of actors is detected (each has their own interest and wants to succeed). In a sense, scientists are themselves stakeholders who have personal agendas (Brinkmann et al. 2015: 10). These ontological foundations relate to basic assumptions of game theory (Nash 1950: 155), where rational individuals seek to maximise their utility defined by individual preferences. The understanding of science in the neoliberal sense relates to more relativistic concepts of science such as i.e. Feyerabend (1986). As there are no general rules which scientific reasoning and methods are appropriate, there is no single "right" way to do science. It depends on the actors' perceptions and constellations.

A characteristic framing of this neoliberal perspective is the notion of "win-win situations" which explicitly acknowledges the win-lose taxonomy in a positive way. In the neoliberal view this behaviour is not perceived normatively (good or bad) but as "natural" or "rational", relating to the rational choice paradigm (Esser 1993; Coleman 1990) where individuals as well as organizations are understood as rational actors that have fixed preferences and strive for optimal choices with regards to these preferences (Geels 2010: 496; Braun 2013:xx). The group politics approach sees scientific controversies as the result of the pluralist bargaining on the political marketplace by different kinds of actors (Martin and Richards 1995). Following that perspective, stakeholder involvement is just another arena for different kinds of actors - such as governmental bodies, individual citizens, economic, social and environmental interest groups as well as different kinds of scientists - to carry out the battle of power and authority.

3.3 Functionalist type

The functionalist type is based on an understanding of society as consisting of autonomous social spheres, or systems as introduced by Niklas Luhmann (1984; Kneer 2000) and further developed by a number of scholars with regards to social coordination processes (Teubner and Willke 1984; Bora 2001; Fuchs 2013; Mölders 2013, 2014). It takes a social-constructivist perspective and presumes that modern society is predominantly differentiated into functional subsystems such as the economic, the political, the legal or the science system that are defined by the kind of relevance criteria – or codes – along which the world is observed.

From a functionalist perspective, stakeholder involvement has the objective to irritate the science system with other social perspectives and relevance criteria in order to trigger learning processes that can make science more sensitive for societal problems (Willke 1983: 25, 1987: 333). However, these self-reflective processes can only be induced, but never enforced. Hence, stakeholder involvement is perceived as an opportunity or random generator that may, by chance, change the research process. In order to generate occasions of irritation, functionalist scientists attempt to integrate 'representative stakeholders' of different societal logics, e.g. from the economic or political systems or civil society organizations. Stakeholders are typically involved in all stages of the research process in order to increase the probability that changes take place. However, this never guarantees that stakeholders' perspectives are well-reflected and adequately incorporated into the research process.

With regards to the understanding of science, this type suggests that the science system consists of all communication that observes the world through the lens of truth – e.g. if a certain observation can be regarded as true or false according to certain theories or methods, which in Luhmann's terms would form the contingent 'programme' of the science system. Compared to the other types, the functionalist has a completely different view on the pre-described roles of scientists and stakeholders since he emphasizes communication over actors. He does not care who observes the world, but only looks at how is it observed (whether their communication is considered scientific or not). The kind of knowledge that stakeholders provide is always related to their respective mode of observation, i.e. depending on the systemic relevance criteria the stakeholders use.

However, as stakeholders such as politicians, business men or civil society activists typically act as 'representatives' of certain social systems, they tend to observe events from a political (power/no power), economic (payments/no payments) or moral (just/unjust) rather than a scientific perspective (true/false). As such, these observations are merely 'noise' to science, unspecified communication that does not (yet) make sense in scientific terms. As science generates 'order' from stakeholders' 'noise' by transforming stakeholders' statements into a scientific kind of information, substantial characteristics of their original meaning might get lost. Consequently, a functionalist attaches relatively low legitimacy to the original stakeholder input. It is this tension between irritation potential and scientific re-interpretation that describes the opportunities and limitations that stakeholder involvement generates from a functionalist perspective. In the strict sense, the science-policy interface does not exist from this perspective since science and politics generate meaning in very different and incommensurable ways. There can be no easy, immediate and substantial exchange or coordination across these different systems, but coordination can be achieved indirectly and probabilistically. Stakeholder involvement is a tool to enhance the probability that self-reflective processes are triggered, especially if they follow a so-called 'irritation design' (Mölders 2013: 15-16 , 2014: 24) that takes into account the social, temporal and factual dimensions of system-specific meaning (Luhmann 2012, cited by Mölders 2014: 3-4). For stakeholder involvement, this means that scientists should first consider which kind of actors have the greatest impact on the focal system, be it the science or the political system (social dimension), for example because they provide relevant insider information or are especially affected by the research questions. Second, scientists should think about the way statements need to be framed in order to become relevant or 'readable' (Fuchs 2013 as cited by Mölders 2014: 4) in the focal system – for example by explicitly linking opinions to ethical debates that are well-anchored in scientific or political debates (factual dimension). Third, good timing is essential and needs to take into account the temporal structures of different systems (e.g. length of review processes in science, election periods in politics, quarterly statements in the economy or rapid changes in societies due to salient event).

3.4 Democratic type

For the democratic type, stakeholder dialogues have the objective to integrate actors in society that are touched by a (complex) transformation or sustainability matters (Ward and Dubos 1972: xx; Schneidewind and Singer-Brodowski 2013: 314ff) into the research process. Especially through the participation of lay people, science can create legitimacy for itself, thus allowing "for the development of a genuine and effective democratic element in the life of science" (Funtowicz and Ravetz 1993: 740f).

From a democratic viewpoint, extending stakeholder dialogues from experts and scientists to civil society can enhance the quality of the research results (Spangenberg 2011: 283). Concerning the kind of knowledge, instead of only taking data and scientific observations into account, subjective probabilities science- and knowledge-based opinions and ideas are integrated into the research process. Also, networks and relationships are of great importance. Wiek 2007: 55) defines this process as collaborative research, where "scientists and local experts not only exchange relevant information but jointly generate (new) knowledge on the basis of their scientific as well as local expertise (joint research)."

By opening all levels of the process to stakeholders, e.g. from the definition of the research questions („Co-Design ", Schneidewind and Singer-Brodowski 2013: 121ff., 182, 211, 314ff.) to answering them („Co-Production"), socially robust knowledge is created (Nowotny et al. 2001: 166) to achieve a "democratization of expertise" (Maasen and Weingart 2005: 53). Besides the impact on the way science as such is conducted, the democratic type also looks at the political implications of stakeholder involvement in science. It argues that stakeholder dialogues are used to improve scientist's policy recommendations and make them more relevant since they reflect a broader range of interests from different stakeholder groups in society. Hence, stakeholder involvement is seen as a means to improve the interconnection and exchange processes between science and politics, alas the science-policy interface. Through this transdisciplinary approach (Wiek 2007; Dressel et al. 2014; Lang et al. 2012_ENREF_43) stakeholder dialogues can help bridge the gap between science and society and allow science to adapt to modern complexity (Bergmann 2014).

To be able to fully make use of this instrument, scientists have to approach stakeholders at eye level (Spangenberg 2011: 283), fostering a dialogue reflecting on their own and on stakeholder's roles. In the sense of Habermas' theory of communicative action, the democratic type believes that a true and valid communication can be achieved if certain rules are adhered to. Thus, through this "ideal speech situation" (Habermas 1990: 122) where there is "power neutrality" and "transparence" (Habermas 1993: 31; 1990: 56f), the "force of the better argument" is the dominant one (Habermas 1990: 198).

The role of the scientist is to facilitate and moderate the dialogue, bringing together different stakeholders from politics, business, research and civil society in an open arena (relating to the concept of the transition arena of Rotmans 2003; Loorbach 2002). The scientists have to translate the belief systems and languages of the different 'systems' while at the same time creating trust and ownership for the research process. The sense of ownership can foster stakeholder's engagement in the process and increase the chance that research results are taken into account by policy-makers. The established cooperation of stakeholders and scientists enables the researcher to follow the implementation of the scientific results and at the same time strengthens the acceptance of political measures in society (Spangenberg 2011: 283). Through the active involvement of the stakeholders they are not merely seen as an object of science.

Stakeholders on the other hand can influence and shape the research process through their engagement (or through other forms of (non)-participation: manipulation, therapy, informing, consultation, placation, partnership, delegation, citizen control (see Arnsteins's Ladder: Arnstein 1969)). Consequently, they play an active role and are typically involved in all stages of the research process –from the definition of the research question to the actual implementation of the scientific findings and the derived policy recommendations. This underlines the idea that the democratic type understands science as a tool to support transformation in society and to ensure representation of all people touched by it.

4. Energy transition research through the lens of the typology

The European Union's research funding program Horizon 2020 provides a useful framework to explore the different types we here discuss, to understand their implications and to illustrate the main controversies arising from each of them when dealing with controversial issues such as the energy transition in Europe and elsewhere. The implementation of the societal or political goals to reduce GHG emissions and increase the share of renewables in energy production in the near future demands scientific research on a large number of technological – e.g. smart grids and energy storage, building energy efficiency among others – and 'sociological' issues such as behavioral changes in consumption, mobility, etc. that require social acceptance for their success. We briefly describe stakeholder involvement strategies in the required research for a transition towards renewable energy and the discontinuity of CO_2 intensive energies in Table 1.

The next section will present an outline of the major critical arguments concerning stakeholder involvement in scientific processes and apply the typology to these arguments.

Table 1: Stakeholder involvement in energy transition research

	Research questions	**Stakeholders**	**Research process**	**Kind of results**	**Kind of projects**
Technocratic type	Generation: Scientifically identified gaps in research Content: Technical questions of the energy transition (wind and solar power, transmission, financial products)	Technical experts (planners, engineers, other scientists)	Generation: Scientists collect and evaluate information without direct influence of stakeholders Content: empirical data and information	Generation: No support of implementation, solely scientific communication of results Content: market assessments, technical feasibility studies	Pathways, case studies, scenarios, technical projections
Neoliberal type	Generation: result of bargaining process of interest groups (including scientists) of the energy transition Content: questions concerning societal needs and particular interests, policy demands, opinions/values	All stakeholders with interest in energy transition (Corporations negatively/ positively affected, citizen initiatives, Policy makers, NGOs, Lobby organizations)	Generation: scientists interpret/evaluate stakeholders' positions during all steps of the research process Content: opinions, information, values, interests	Generation: support of implementation to bring results into the political or societal arena (incl. media) Content: policy recommendations, studies	Scenarios (decentralized/ centralized, role of efficiency, technology development, role of nuclear energy) opinion polls, events, studies
Functionalist type	Generation: Scientifically identified problems Content: questions integrating social dimension of energy transition into science system	Powerful (and thus vocal) stakeholders from all affected social sub-systems: politics, economy, science, civil society	Generation: scientists involve 'representative stakeholders in all stages of research process to irritate science system with other social perspectives (random generator) Content: system-specific knowledge	Generation: enhance probability of self-reflective processes in the science and implementing systems through 'readable' framing and good timing Content: translated knowledge such as science-based policy recommendations	Studies, events, workshops (Bayesian Risk assessments for investments in different forms of energy production; social acceptance of new technologies (demand-side management, electric cars)
Democratic type	Generation: socially relevant problems arising from dialogue process Content: problems that hinder the energy transition/ questions that integrate needs of all stakeholders supporting the energy transition	All stakeholders affected by energy transition (Corporations, citizen initiatives, Policy makers, NGOs, Lobby organizations, citizens)	Generation: scientists take into account stakeholders' positions during all steps of the research process Content: opinions, information, values, interests	Generation: support of implementation through dialogue with stakeholders Content: policy recommendations, studies, opinion polls, assessments	Scenarios (decentralized/ centralized, role of efficiency, technology development, role of nuclear energy) opinion polls, events, studies

5. Discussion

This paper aims at a better understanding of the critique raised against stakeholder involvement in science. Following debates in science and society, we identify three major critical topics: First, the question of the legitimacy of stakeholders' claims as input for scientific purposes. Second, there is the issue of communication process that can be perceived as ranging from pure bargaining to deliberation addressing the science-policy-interface. Related to this is the more encompassing question of the autonomy of science that scientists uphold when working with stakeholders. Using our typology as a heuristic tool, we systematize the critical arguments on three respective continua (Fig 1), showing the implications the different types have for stakeholder involvement.

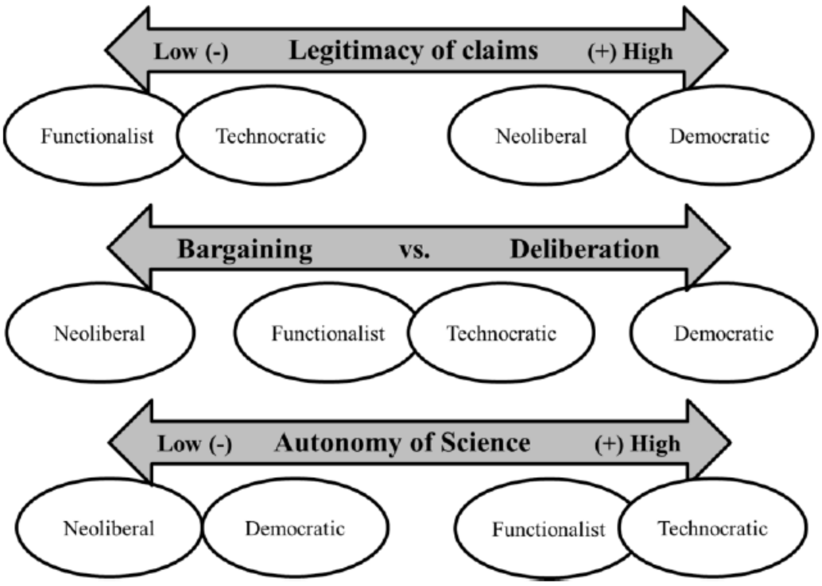

Figure 1: Critical continua of stakeholder involvement in science

The critique is most strongly directed against the types that are located at one of the ends of the respective continua and, accordingly, it is often issued from a perspective located at the opposite end of that continuum. The legitimacy of claims differs most strongly from the perspectives of the technocratic and the democratic type. When it comes to the question of bargaining vs. deliberation, the neoliberal and democratic types represent the most divergent perspectives. Concerning the autonomy of science, the critique stems from a rather technocratic or functionalist understanding of science and it is especially directed against the democratic and neoliberal type.

5.1 Legitimacy of claims

In literature and interviews, we find that one of the most contested problems is the scientific legitimacy of stakeholder input in the research process. Thus, the perception of the knowledge that is created through stakeholder involvement in scientific research processes is discussed. How much of the knowledge offered by the stakeholder is relevant and thus can be used by the scientist (to answer the research questions) – as data, as opinions, as information? How strong does the scientist distance himself or herself from the claims ranging from acknowledging all input as honest to looking through the "objective" lens of science?

On a practical level, the difficulty to differentiate between strategic communication and biased information by stakeholders is a main challenge for scientists. But not only stakeholders might use strategic communication. Funding organizations or researchers may also emphasize "win-win" situations when they want to persuade stakeholders to participate even if their main motivation the democratization of scientific processes. Another critical point discussed in literature is whether the opening of scientific processes to non-academic actors might threaten scientific sovereignty of interpretation by challenging intra-disciplinary criteria of knowledge production (Weingart 2011: 135).

On a theoretical level, criticism of the position that scientific knowledge can be described as 'pure' or objectively true has been formulated from different angles in the social sciences for a long time. To mention just a few examples, Michel Foucault retraces the co-constitutive relation between knowledge and power (Foucault 1995: 27). Paul Feyerabend argues that there can be no universal or definitive criteria for scientific methods or theories and that scientific claims are just as valid or invalid as claims from other spheres such as antique Mythology (Feyerabend 1986: 21, 55ff., 249ff.). Constructivist scholars highlight the social embeddedness and observer-dependency of all knowledge (Berger and Luckmann 1966; von Glaserfeld 1995). Consequently, the criteria, theories or methodologies which define "valid scientific knowledge" are dependent on the scientific sub-discipline (Strohschneider 2014: 184). Relating this to stakeholder involvement, the way claims are treated is dependent on the researcher's understanding of science.

We refer to the critical trade-off that arises in such situations as "legitimacy of stakeholder claims/input", describing the kind of stakeholder knowledge that the scientist uses in her research process and how she uses it. The continuum reaches from low legitimacy, seeing stakeholder claims as mere noise in the Luhmanian sense, to taking all claims as honest and true (high legitimacy). Adding to the kind of knowledge, the continuum thus also describes how strongly scientists distance themselves from the stakeholder input.

Applying the four different ideal types to this continuum can help to better understand the critique. The functionalist type stands on the far low end, seeing all claims as unspecified ‚noise‘ that is ‚senseless‘ unless transformed to the code of the science system. The technocratic scientist believes in the objectivity of science and thus expects stakeholders to provide only data (via lay-people) and technical information (via experts). The neo-liberal type is characterized by a high legitimacy of claims since following the logic of mathematicians like Nash, all players know the rules and act in their best interest. All statements are interest-driven and equally valid (or invalid) and thus interests are brought into the research process via inclusion of stakeholder knowledge. The democratic type sees all stakeholder claims or input as honest communication and takes them seriously in the research process. He thus takes into account data, information, science- and knowledge-based opinions, ideas, subjective probabilities, networks and values. Following Habermas' theory of communicative action (Habermas 1990), in a perfect speaking situation, there is no strategic communication.

Considering the critique that stakeholder involvement (or the opening of scientific processes to non-academic actors) might pose a threat to scientific sovereignty of interpretation by integrating 'un-scientific' kinds of knowledge and challenging intra-disciplinary criteria of knowledge production, the technocrat and the functionalist would agree, whereas the democratic and the neoliberal type believe that stakeholder involvement enhances scientific results. According to the democratic view, involving stakeholders into research processes can help to expand the perspective of "mainstream science" by incorporating the context-specific knowledge and value judgements of those affected by the research. Also, creating solution-oriented knowledge is considered a goal (Lang 2012: 29f). In the case of the neo-liberal, equally legitimate interest would contribute to the research.

5.2 Bargaining vs. deliberation

Another major criticism of stakeholder involvement in science relates to the question of interest-driven vs. deliberative stakeholder communication. How much convergence or divergence exits in regards to "operational codes of science and politics" (Hoppe 2005:207)? There is a mismatch between the positive notion of including the affected and concerned into the former "isolated" scientific research process and the perception of stakeholder involvement as another means to channel specific economic or political interests into research results. The latter is discussed as hampering the "neutrality" of research. Framed differently, this critique addresses the science-policy interface and thus the question whether stakeholder involvement supports a democratization process in science or allows for implicit or explicit lobbying of powerful actors in another societal area.

Even if scientists are perceived as conscious concerning the material interest stakeholders have, they have to rely on stakeholder's input into the research process (knowledge mismatch). Stakeholder dialogues mostly involve different kinds of actors – ranging from single affected citizens to politicians, administration, NGOs, companies, consultancies and lobby organizations. Actors need time and resources to participate, plus a strong motivation/interest. As Mancur Olson (1965) has shown, interest groups in democratic societies have very asymmetric chances of organizing themselves and voicing their values, interests and concerns. Especially large and dispersed groups such as citizens, tax payers or consumers are often unable to form interest groups that match the well-organized interests in society of i.e. economic branches (van de Kerkhof and Wieczorek 2005: 737ff). Generally, stakeholder dialogues in science do not involve political decision-making, thus we do not further elaborate on possible motives in that field, but make one point: influencing the public discourse by labelling and enriching and thus legitimizing specific interest-related positions with the "neutrality" and "objectivity" claim of science could be a motivation for stakeholders to participate.

All this said, the selection bias (who is able and who is willing to take part in a stakeholder dialogue and how do scientists chooses stakeholders) is a main criticism towards stakeholder involvement in science. On a more general level, this leads to the question whether stakeholder input is understood as a part of a deliberative democracy or as part of the bargaining power play of politics.

Depending on the type of stakeholder involvement in science, the views on this critique differ strongly. On the bargaining side, the neoliberal type sees the science-policy interface as a "battlefield" where all actors anyway bargain for their interest (Nash 1950). Stakeholders can be lobby groups/individuals who try to channel their interests into research process and indirectly into the political arena. On the other hand, the scientist tries to influence political decisions. Thus, although the neoliberal type understands the process as determined by interest and power, he does not perceive it as a threat or danger. The functionalist type though is indifferent to both bargaining and deliberation since he sees no overlap of the political and the science system especially when they communicate with each other. Scientific findings might become relevant for politicians if they trigger reflection in the political system through irritation, but that happens only by chance. The technocratic type is slightly closer to deliberation than the functionalist, believing that ‚explaining' the world instead of convincing political actors is the right way. This bears the underlying idea that science is objective: and scientists ‚speak truth to power' (Pohl and Stoll-Kleemann 2007: 10f.).

On the deliberation side of the continuum, following Meadowcroft's (2004) idea of group-based deliberation is the democratic type. Here, the scientist aims at the "democratization of science/expertise" and wants people/groups touched by transition (or energy transition) to be represented in the research process as well as science to support the (energy) transition. The involvement of citizen-stakeholders might remedy the influence on scientific results by powerful and well-organized interest groups in society. Another aim is to improve interconnection and exchange processes between science and politics. The democratic type understands stakeholder involvement as a way to increase relevance, legitimacy and fairness when certain standards are met. From a more pragmatic view, the so-called "democratization of research/science" may decrease the quality of research results. Following our typology, the technocratic and the functionalist type would argue that political goals (i.e. taking binding decisions according to opinions, preferences or value judgements based on voting) can not be transferred into the scientific realm without fundamentally changing the nature of science. The technocratic type would fear that scientific standards are softened, the functionalist would regard such a tendency as a creeping process of de-differentiation or re-programming by which non-scientific criteria such as social relevance substitute or modify the originally scientific criteria of true and false.

5.3 Autonomy of science

When designing stakeholder involvement, the question of the integration of stakeholders in the research process arises. On a meta-level, this can be summarized as a question of the autonomy or primacy of science . Should stakeholders already be included in the definition of the research questions and design process or is it enough to integrate their knowledge later? Literature on stakeholder engagement in science shows that important questions regarding this issue are still far from being answered (Niederberger and Wassermann 2015: 12; Hanson et al. 2006: 132; Lang 2012: 35ff). How can the relation of scientific and non-scientific knowledge be described? (Habermas 1990). By which scientific or democratic criteria can different kinds of stakeholder input in the research process be evaluated? Is this evaluation carried out by scientists alone or jointly with the stakeholders? What is the role of the stakeholders: are they supposed to provide insights and perspectives that can lighten up the blind spots of science, or are they actually doing science themselves?

In this context, stakeholder involvement concepts are criticized for their understanding of science and the science-society relationship it entails (Strohschneider 2014: 180; Weingart 2003: 99). With regards to 'transformative science' (Schneidewind and Singer-Brodowski 2013), Peter Strohschneider (2014: 184) identifies four central motives that might lead to the decline of scientific autonomy and pluralism. The most challenging ones are ‚solutionism' and ‚de-differentiation'. The term 'solutionism' describes the framing of research topics as practical problems that scientists try to solve. Strohschneider argues that a solutionist concept of science, which privileges directly relevant findings over more indirect effects of science (such as basic/ foundational research) and questions on design and societal impact over understanding, is reductionist. De-differentiation means that the sphere of science is no longer regarded as an autonomous societal arena that defines its own standards and categories such as the constitution of scientific knowledge or the choice of research topics. Rather, there is a tendency to equate scientific problems with problems of immediate social relevance. According to Strohschneider, this solutionist understanding of science in which epistemic problems are only considered scientifically legitimate if they can be labelled as societal problems (Strohschneider 2014: 183) poses a threat to the autonomy of science.

The typology shows that this critique applies above all to the neoliberal and democratic type that show a low differentiation between scientists and stakeholders (left end of the continuum) and thus low autonomy of science. In the tradition of Feyerabend (1986), the understanding of science as a separate arena of society with distinct and clear criteria of valid knowledge production, as defended by Strohschneider, is no longer taken for granted. Consequently, the roles of scientists and stakeholders barely differ, and stakeholders have a much higher impact on research. The neoliberal type which relates to the ontological foundation of game theory (Nash 1950) sees no divergence between stakeholder and scientist since they both act as rational utility-maximizers. The posed research questions thus do not only depend on epistemic interest, but also on the possibility to get research funding or to further one's material interests through the research. Though on different, more morally oriented grounds, the democratic type rejects a differentiation between stakeholders and scientists and opts for integrating everyone affected as extensively as possible – from the definition of the research question to the structuring of the research (Hirsch Hadorn et al. 2006: 125; Spangenberg 2011: 283). The research questions are not limited to epistemic interest but aim at offering solutions for socially relevant problems.

In contrast, both in terms of the involvement of stakeholders in the research process and the underlying understanding of science, the technocratic type seems to be closest to a classic understanding of science in the tradition of Karl Popper (1957) that sees a strong qualitative difference between trained scholars and lay stakeholders. The scientist is in charge of the research design and merely consults stakeholders if he or she feels they can provide useful data or information. The research questions typically deal with intra-scientific debates rather than societal needs. The functionalist type also perceives science as an autonomous arena with distinct relevance criteria that differ substantially from those of the economic or the political system. As in these more classic perspectives on the science-society relationship the motives of 'solutionism' and 'de-differentiation' are rejected, Strohschneider's critique does not apply to them.

6. Conclusion

There is an increasing trend of including stakeholders in research concerning sustainability or transformations like the energy transition. Though frequently used, little theoretical reflection on the underlying concepts of stakeholder involvement in science by the practitioners themselves exists so far. With the typology described here, this paper tries to fill this research gap by offering a heuristic, self-positioning and decision-making tool for stakeholder involvement in scientific research processes. The differentiation of four different ideal types linked to the critique that has been voiced among practitioners and in the academic literature can help scientists to better understand the different concepts of stakeholder involvement and potential pitfalls in designing it. By identifying and analysing three major critical topics with our typology –the legitimacy of claims, the idea of bargaining versus deliberation and the autonomy of science – we reveal critical choices that every scientist involving stakeholders should be aware of, thus giving an impulse for further discussion in this field. Our analysis also shows that – even though in literature it is often framed in the notion of the "democratic type" – there is no singular concept of stakeholder involvement. With the application of our typology to the energy transition, we emphasize one of the major fields where stakeholder involvement is currently strongly used and at the same time link practical and theoretical level in the discussion.

The tool presented here can only be an aid of orientation concerning the three major critical points of stakeholder involvement as addressed in this paper. The challenges of societal transitions will keep challenging science – especially the question of its autonomy among claims of democratization and vested interests and its input between scientific and non-scientific knowledge.

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