Stakeholder empowerment in participatory processes of the energy transition - an evaluation of impacts of simulation tools

Judith Fiukowski[a,b], Berit Müller[a], Elisa Gaudchau[a]

[a] *Reiner Lemoine Institut (RLI)*
[b] *Free University of Berlin (FU)*

Abstract

Civil society participation in discussions about the transition of energy supply and demand structures is challenging due to limited access to technical and systemic knowledge. The asymmetry of knowledge between experts and non-experts can undermine the credibility of participatory processes. There are open-access-tools which are intended to improve the ability of stakeholders to engage in discussions as for example simulation-based tools that can provide insights into complex interactions. This paper summarises the results of our research about the question: To what extent do simulation-based tools empower stakeholders in participatory processes of the energy transition? This was done by a survey and categorization of existing tools followed by a qualitative evaluation of four cases and a concluding workshop where we discussed our resulting theses with experts from the different stakeholder groups. To define empowerment we drew on the participation pyramid by Rau et al. (2012) and Lüttringhaus (2003) consisting of four hierarchically sorted levels: Information, consultation, cooperation and delegation. The analyses showed 1) that tools can bring the discussion of a participatory process to a more objective level, 2) that to address user needs they must be involved in the programming process, and 3) that context variables influence the impact of a tool. Therefore, it is not only the tool itself that determines the outcome, but also the settings in which it is deployed. In this study we refer to simulation tools that reach at least the first steps of the participation pyramide as *stakeholder empowerment* (StEmp) *tools*. The full collection of added values of StEmp Tools, possible problems and requirements for future tools can be found in the flow chart, which has emerged from the workshop (see results).

Keywords: participation, empowerment tools, sustainable energy supply

1. Introduction

More than 80% of total greenhouse gas emissions in the EU are caused by the energy sector which makes the transition of the energy system one major challenge to climate change mitigation. Action planning and mitigation measures must consider interlaced systems such as political, economic, scientific and societal systems and the diverging interests of actors. The functioning and process organisation of different participation patterns to bring these actors together have been analysed in various research projects. However, research examining the mediation and organisation of the discourse between different stakeholders of the energy transition is scarce. [1], [2], [3]. Discussions about political, technical or juridical measures are often lead by experts only because other stakeholders such as the civil society have limited access to technical and systemic knowledge. This asymmetry can undermine the credibility of participatory processes. There are tools which are intended to improve the ability of stakeholders to engage in discussions and contribute their specific knowledge. In this paper we will refer to them as *stakeholder empowerment* (StEmp) *tools*.

2. Objectives of the reserch

Tools based on simulations can provide insights into complex interactions (e.g. interrelationship between heat, electricity and mobility sector, climate influences, relevant players, etc.) and calculate impacts of specific measures. There are open source tools with different degrees of complexity for modelling the energy system and processing energy data. To our knowledge, there are no studies to date that evaluate how such tools empower stakeholders to participate in trans-disciplinary dialogues concerning the transition of the energy system. This work addresses this gap in research. An additional aim of this paper is to identify the requirements for tools that can empower stakeholders as well as the limits and potential of their design.

3. Theoretical framework

The transformation of energy systems is very challenging as the need to change socio-technical systems implies the restructuring of deep-rooted societal systems, the implementation of new technologies and policy innovations. In this context different patterns of participation have been applied to either resolve energy conflicts, decrease opposition or to improve and secure the planning process. Participatory governance approaches on energy transition describe the democratic participation through deliberative practices of citizens. Therefore, Borrás and Edler (2014: 28) [6] state: "The complex nature of socio-technical systems makes the participatory and effective governance of change in socio-technical systems more dependent on knowledge of citizens and experts alike." In climate and energy research, model-based studies have become the dominant form of knowledge production. Energy scenarios are based on energy models and certain assumptions of outcomes to assess future energy developments (Karjalainen et al. 2014: 30)[7]. These model results and scenarios are of decisive importance for scientific policy advice (Dieckhoff 2015: 14 ff) [8]. However, the recipient (politician, administration, the economy and the civil society) needs profound model and systemic knowledge to understand the results and to be able to check the model towards its plausibility and validity.

We assume that simulation-based tools can be used to compensate the differences in knowledge and help to enable an equal discussion in which every participant can make a contribution. The tools consist of a user interface and an energy model as the mathematical framework. The parameters entered via the tool interface are simulated using the model which is implemented in the tool (as a software). The impacts of tools in participatory integrated assessments as well as participation in the modelling process have been part of research efforts. Tuler et al. (2017: 25) [9] describe participatory modelling as a way of bringing stakeholders together to organize information about complex systems into tools that are more useful for local decision-making than those designed by scientists and decision makers alone." These tools can be further used as instruments in participation processes. In result, tools are promising instruments, but summarizing the state of the art, they have often failed to fulfil all the expectations that were put into them (compare De Kraker et al. 2011 [10] and Siebenhühner/Barth 2004 [11]). That is why this paper concentrates on the ability of tools to empower Stakeholders in participatory processes. The empowerment perspective has not yet been covered by researchers, although it is essential to compensate asymmetries in knowledge and develop a proper understanding of the local energy system. Varying approaches and understandings of participation have led to different typologisations in order to show the differences and similarities in their interpretation and conceptualisation of participation (Reed 2008) [2] . In this context Arnsteins "ladder of participation" (1969) [12] is one of the most quoted approaches. It differentiates between participation and non-participation. According to Arnstein's understanding, a sharing of power is necessary to truly enable participation of marginalized groups. Therefore, forms of information or consultation remain "degrees of Tokenism" (Arnstein 1969) [12]. Lüttringhaus (2003) [5] and Rau et al. (2012) [4] have a similar approach, but instead of differentiating between participation and non-participation, they take up the ladder-model of Arnstein and attach to each stage or step a different strong influence. In their definition, participation starts already on the first step. They come up with a pyramid structured into five hierarchical steps that we also used for our evaluation: Information, consultation, cooperation, delegation and self-sufficiency. We further assume that the tools are the structuring instruments in the process to reach the steps. The information level includes, on the one hand, an explanation part of the functionality of the tool and, on the other hand, a thematic introduction supported by the tool. Consultation describes the discussion in which the individual points of view can be depicted via the tool and thus the tool is the basis for the discourse. The cooperation stage stands for the joint scenario construction through the tool. The stages of consultation

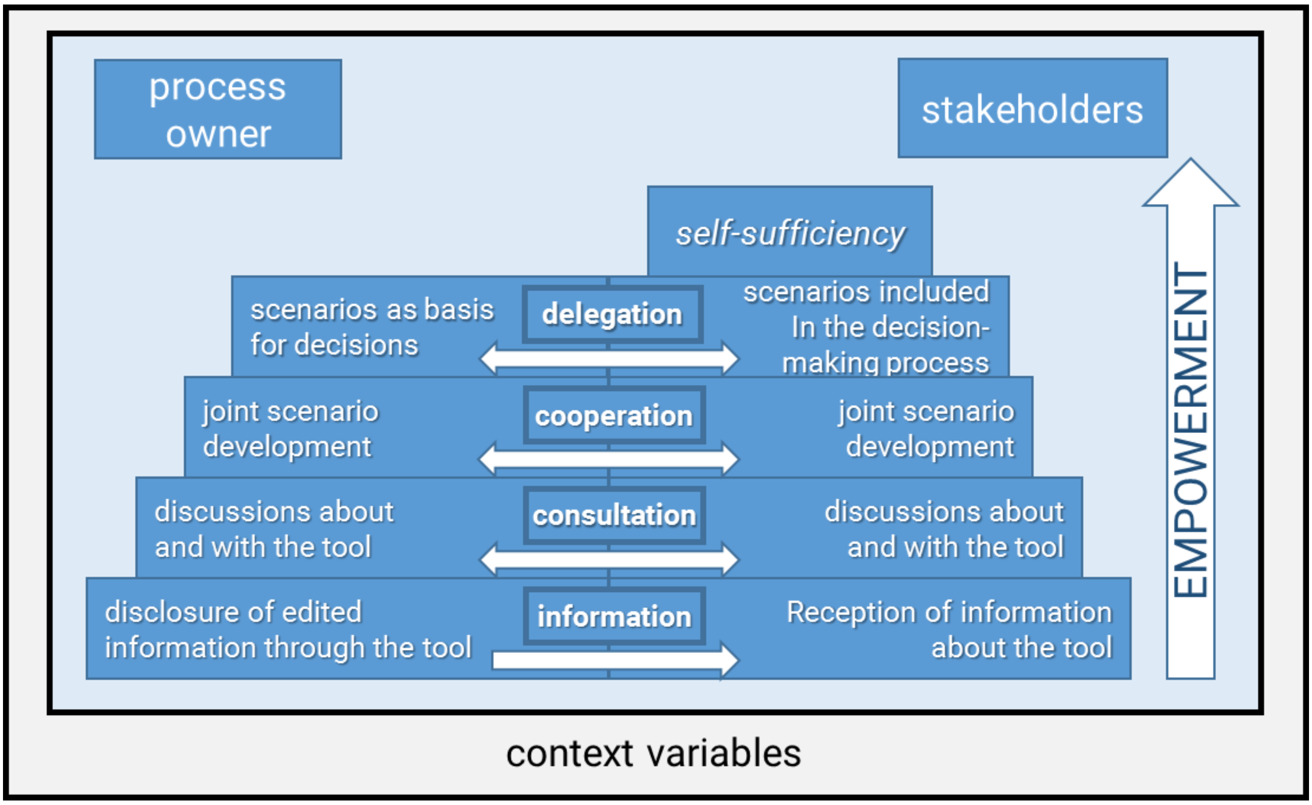

Figure 1: The five levels of stakeholder empowerment own depiction based on Rau et al.2012 [4] and Lüttringhaus 2003 [5]

and cooperation partly overlap, since the discussion and the scenario construction are often interwoven in the participation process. The level delegation describes a shared responsibility which means that the results will be considered in political decision-making. The level of self-sufficiency is listed here as an "ideal type", following Lüttringhaus (2003) and Arnstein (1969).

In the paper of Späth and Scolobig (2016: 190) [3] participation and empowerment have been linked: *Participation and empowerment of stakeholders start as soon as stakeholders are engaged in the process.* Späth und Scolobig (2016: 190) argue further: *The empowerment levels of stakeholders in a process, although mostly not at the highest rungs as described by Arnstein, can still be evaluated. Therefore, an empowerment scale is appropriate to evaluate the way stakeholders are embedded in a process.* In accordance to Späth and Scolobig (2016) we also link the degree of participation with the degree of empowerment in this paper. Although stakeholders from politics and administration already have decision-making power we argue that they have to be empowered to implement the energy transition in their region. Therefore, they need the necessary technical know-how, but also ensure the societal feasibility of the transition process (Alcántara et al. 2016: 128 ff) [13].

4. Methodology

Our analysis consists of three parts: We started with a survey and categorization of existing simulation-based online-tools followed by a qualitative comparative case study. Finally, we conducted a workshop to discuss our results and hypotheses with experts from different stakeholder groups. With the survey of online-tools we wanted to get an extensive picture of the distribution and subjects of the existing online-tools. This survey is not representative. It is more about creating a comprehensive overview. Therefore, we researched tools in English and German language. We only considered simulation-based open-access online tools, which prepared energy related issues. We especially focused on the official online appearance of the USA, Canada, Australia, Great Britain, the European Union, Germany, Austria and Switzerland. To analyse the impact of the tools in terms of the empowerment of stakeholders, we conducted an exploratory comparative case study. In order to do so, we have chosen four cases. The cases had to fulfil the following criteria:

1. The tools have to be simulation-based and usable to create energy scenarios
2. The tools have to be applied to support the regional implementation of the energy transition in Germany.
3. The tools must have been deployed more often by the same person (workshop moderator) in different informal participatory contexts. In this way a better comparability of the similarities and differences and a better control of the context variables shall be ensured.

We decided for four cases complying with our criteria: *100prosim* is an excel-tool for yearly balanced calculations of the energy supply for any German region with the aim to reach 100% renewable energy. The potential as well as the need of renewable energy sources can be determined including the electricity-, heat- and transport sector. The consumption sectors household, commercial, industrial and transport are considered as well as the reduction of energy demand. The users can build their own scenarios and discuss the different approaches. The tool was built proactively by one developer.

With the *Berlin heat calculator* it is possible to analyse the influences of the building refurbishments, energy sources and the heating type of Berlin (residential) buildings on the primary energy balance and the CO_2 balance. The potential of different measures can be visualised through graphics. It can also determine the renovation costs of the (different) scenarios. It was commissioned by an NGO to support individual discussions with various stakeholders about measures that should be included in upcoming policies.

The *Open-Source-Energy-Model Schleswig-Holstein* (OpenMod.sh) was developed for the region of Kiel to support public workshops to develop a Masterplan for climate protection. It is an optimizing tool calculating in time steps of one hour and providing the possibility to include heat, electricity and gas.

Erneuerbar Komm is a tool that provides the regional potential of the energy sources wind, PV, water and biomass. It reflects the relationship between generated electricity and the required area. It is an easy to handle online tool that answers the question: which percentage of the regional electricity demand of private households can be covered by sun, wind, biomass and water from the region? The last two tools have been developed as part of ongoing projects.

To evaluate the degree of empowerment of the participating stakeholders, we conducted seven guided interviews with the developers of the tools and with the moderators who lead different workshops with the tools and additional with one communication expert who conducted many participatory processes concerning regional energy questions. The interviews took about an hour and have been recorded. The evaluation was made via the participation pyramid (see 1. As this is an exploratory study, we derived 5 hypotheses from the analysis and developed the concept of Stakeholder Empowerment Tools (StEmp Tool).

The hypotheses and requirements concerning the development of future StEmp Tools were discussed in a concluding workshop with 15 stakeholders from different backgrounds (amongst others developers and users as well as prospective users).

5. Results

Results from the tool-survey: We gathered more than 130 tools and clustered them according to their type and their main subject. The 6 type clusters were web-tools, visualisation-tools, mapping-tools, excel-tools, games and software. The content related categories to which the tools were assigned were energy systems, electricity, heat, mobility, grids, efficiency, climate adaption, climate mitigation, economic feasibility and policies. 31 of the analysed tools address energy systems and 57 of them are web-tools. Figure 2 gives an overview of the thematic categories the tools belong to as well as on the share the various types of tools have.

The following two hypotheses include a summary of the observed connections from the tool review. These are supposed to be considered more as a tendency than as causal connection. They serve as indication for further research.

- The more specific the tools treat a certain topic, the more difficult becomes the access for non-specialist users, which could restrict the empowerment effect.

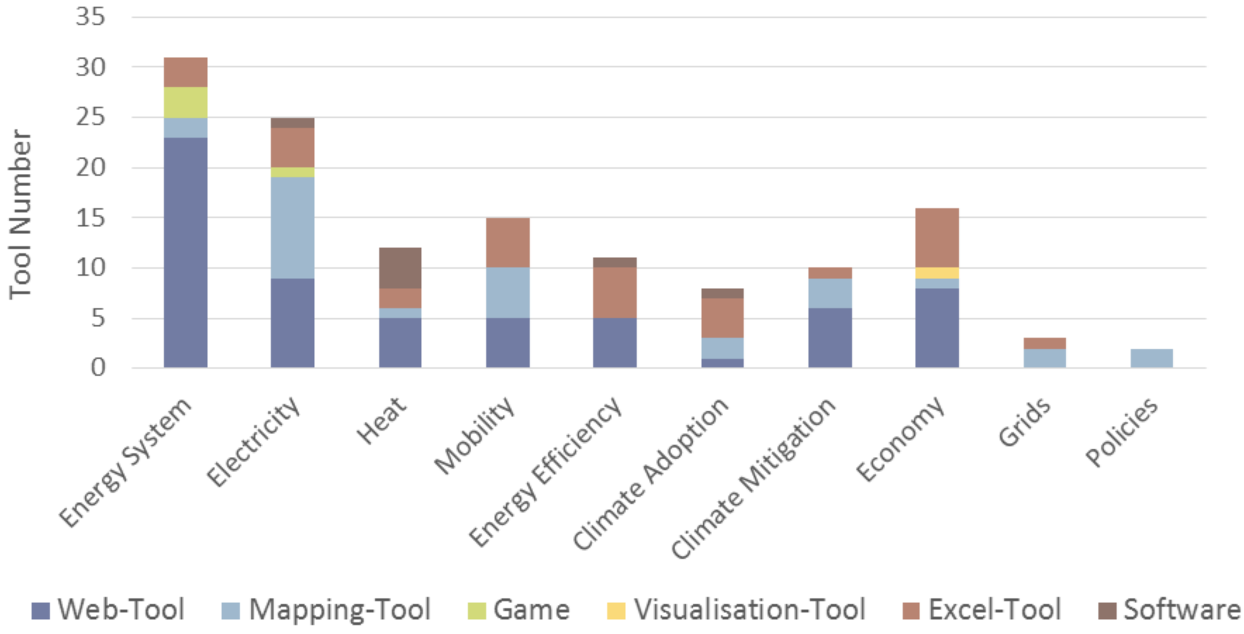

Figure 2: Analysis of the tool landscape

- The more flexible one can adjust the parameters, the more special knowledge is necessary to use the tool, which could restrict the empowerment effect.

The survey is the starting point for the subsequent comparative case study which was necessary to work on questions regarding the impact since the effect of empowerment is hard to evaluate for pure online tools.

Results from the qualitative case study: Regarding our research question the degree of empowerment depends not only on the tool itself, but also on the process design. This has to meet the basic requirements for participation processes design as described by Webler and Renn [14] (e.g. time management, process organization, etc.) and the context variables (the values of the participants, the specific socio-economic factors of the region, etc.). They varied in the evaluated cases and are hard to control. Thus, context variables are the limiting factors of this study. We summarize the results of the four case studies regarding the most important points of the development phase of the tools and the degree of empowerment in relation to the levels of the participation pyramid and the future perspectives of tools in participation processes.

An important finding of the development phase is that there has been a close cooperation between the developer side and the user side (workshop moderator). This is necessary to bridge the technical aspects with questions of practicability for the participatory process. However, this has led to conflicting objectives in the development phase as the developers were emphasizing the importance of depicting the complexity of the energy system whereas the user side focused more on reducing the interface on the functions that can be used and mediated in a participatory process. Working on this conflict together was reported to be helpful for both sides. The users learned about the interaction of modelling and user interface and the modellers reflected their work in terms of the ease of use Furthermore, in two cases (Erneuerbar Komm and the Berlin Heat Calculation Tool) the definition of the assumptions during the development phase has been participatory. According to the interviewee this has led to a higher acceptance of the tool and an understanding of its technical functioning.

Concerning the implementation of tools in various participatory processes interviewees reported that stakeholder tools helped them to better understand the field and to feel comfortable participating in discussions with subject-matter experts. By reconciling the case studies with the participation pyramid, we identified high levels empowerment. In all cases the level *information* has been reached. We considered the levels *consultation* and *cooperation* together since they partly overlap. The complexity of the tool in relation to the level of prior knowledge of the participating stakeholders and the time frame in which the necessary knowledge could be conveyed to the them was critical for either reaching these steps or not. Therefore, integrating all stakeholders in the scenario construction was not possible in all cases due to the high complexity of one tool (OpenMod.sh). In the context of these two levels the impact of the tools on the discourse is another important aspect. According to the interviewees a strength of the tools is that they can structure discussions and make them more concrete because the participants have to decide upon concrete Input parameters. Due to focusing on facts, e.g. geographic conditions, technical aspects and measures resulting from joint calculations, emotions can be percolated. Achieving the level of *delegation* depends on the process not on the tool. Even though there are differences between the analysed tools nearly all of them were used to create regional climate protection concepts. Especially for this relatively open process with specified objectives, this kind of simulation tools proved to be useful. Therefore, we concluded that high levels of participation and thus of empowerment can be achieved through tools.

Concerning the online availability of the tools the assessment of the interviewees varied significantly. While half of them stressed the point that an application without energy system and model knowledge can lead to misinterpretations unless the tool interface is so restrictive that the users can hardly configure the system according to their needs, the others rather stated that low-threshold online tools will be very useful to gain more common understanding of the energy subject.

The following hypotheses derived from our work:

H1: The more the process design and the discussions are oriented on the design and the functionalities of the tool, the higher is the degree of empowerment of the involved stakeholders.

H2: If the development process of the tool was participatory the acceptance of the tool enhances and then the degree of empowerment of the involved stakeholders increases.

H3: The higher the acceptance of the tool as a valid and effective instrument, the higher is the degree of empowerment of the involved stakeholders.

H4: The better the tool can balance the different knowledge levels of the stakeholders, the higher is the degree of empowerment of the involved stakeholders.

H5: If the context variables enable an open discussion with politically relevant results as well as an individual process design that takes the specific regional socio-structural conditions into account, then the degree of empowerment of the involved stakeholders increases.

Conceptualization of Stakeholder Empowerment Tools (StEmp tool) The analyzed four tools have not been developed with the aim of empowering the participants. Therefore, the concept of StEmp tool is intended to be the basis for future tool developments aiming to increase the ability of stakeholders to participate in complex issues. Additionally, this concept shall help to overcome the shortcomings identified in the application of tools. Consequently, StEmp tools have to be simulation-based as the application of these tools is in the area of model-based decisions-making. Moreover, a regional orientation of the tool does help to establish a direct relation to the local stakeholders. The need of political, societal and economic stakeholders for empowerment is the need of prepared knowledge, local data, transparency and communication with each other. Therefore, a StEmp tool has to be based on concrete regional requirements. The transparency of the tool requires conceptually two things: Firstly, the tools have to be developed based on open source software and licenses to guarantee a free online use. The goal is to open up new information channels. The online availability, however, must be accompanied by comprehensive user guides, especially when it comes to complex tools. Secondly, the stakeholders must also be included in the definition of the underlying assumptions. In two cases this procedure has proven to be helpful. It has increased the acceptance of the tool and ensured that the tool deals with the relevant questions for the stakeholders. Another aspect of StEmp tools is that they are used in participation processes and thus have a clear, practical orientation. Since the degree of participation corresponds to the understanding of empowerment in this work, this is also transferred to the StEmp tool concept: The Participation processes in which tools are used have to have a clear empowerment aim and therefore enhance the discourse and dismantle knowledge asymmetries.

Results from the workshop: The evaluation was concluded with the workshop to discuss and concretise all findings with a larger group of experts. There was a broad consensus about the results especially that the interactions of process design and tool requires further research. The discussion focused on added values of StEmp Tools, possible problems and requirements for future tools. Subsequently we developed a flow chart (see figure 3) covering the workshop results.

6. Conclusions

This paper is an empirical study consisting of two parts to investigate the research question. First we surveyed the existing online-tools and then a comparative case study with four cases was carried out. Through the comparative case study, we have explored five hypotheses, which illustrate the relationship between tool application in participatory processes and the empowerment of the participating stakeholders. Tools are no new formats of participation they remain an instruments that can enhance the participation process. In the process, the tool provides the framework for the technical feasibility and the stakeholders provide the input concerning the social practicability. In result tools as instruments in participatory processes have a great potential for empowerment, which has been proven in the four cases. However, this potential can only be realized in relation to the process design and the context variables. In addition, the workshop leader has an intermediary role and mediates between development and application, and thus technical design and practical use, thereby he can act as multiplier.

Tools as instruments in processes of participatory climate change governance at the local level help to increase the transparency of the energy issue. Furthermore, the tool as the basis of discussion can improve the communication between the participants because also participants without prior expert knowledge in energy subjects can contribute their views into the discussion. The complex coherencies of the local energy system are prepared and mediated through the tool, whereby new impressions, perspectives and new knowledge can be gained by the stakeholders. In this way politicians as well as for example actors of the civil society gain new insights and can jointly decide about the scenario construction and therefore about the implementation of the energy transition. This corresponds with the political value of the tool application. Tools open up the blackbox of energy modelling which improves the political connectivity of the scenarios and workshop results. However, to ensure the political implementation, the level of "delegation" must be achieved in the participatory process. In two of the four analysed cases this have been achieved.

The process design has to be precisely tailored to the tool and the other way around the tool development has to consider the application of the tool in participatory processes. However, the limiting factors of the tools remain the context variables. Therefore, further research needs to be done to validate the hypotheses of this study and to analyse further application of tools. Additionally, we have not covered the usage of tools in energy conflicts. In emotionalised contexts it is very questionable whether instruments that aim to bring new knowledge and perspectives into the group are accepted at all.

Acknowledgement

The authors thank the *German Federal Ministry for Education and Research* for funding the research project *ENavi* as part of the Kopernikus projects.

7. Literature

[1] J. Ried, M. Braun, P. Dabrock, Energiewende: Alles eine Frage der Partizipation? Governance-Herausforderungen zwischen Zentralität und Dezentralität, in: Zeitschrift für Energiewirtschaft, 2017.

[2] M. Reed, Stakeholder participation for environmental management: A literature review, Biological Conservation, October 2008, Volume 141, Issue 10 pp. 2417–2431.

[3] L. Späth, A. Scolobig, Stakeholder empowerment through participatory planning practices: The case of electricity transmission lines in France and Norway, Energy Research Social Science, 2016, Volume 23, pp. 189 – 191.

[4] I. Rau, P. Schweizer-Ries, J. Hildebrand, Participation. The silver bullet for the acceptance of renewable energies?, in: S. Kabisch, A. Kunath, P. Schweizer-Ries, A. Steinfuhrer (Eds.), Vulnerability, Risks and Complexity: Impacts of Global Change on Human Habitats, Hogrefe, Göttingen, 2012 pp. 171–191.

[5] M. Lüttringhaus, Voraussetzungen für Aktivierung und Partizipation, Lüttringhaus, M.; Richers, H.: Handbuch Aktivierende Befragung. Konzepte, Erfahrungen, Tipps für die Praxis, 2003 pp. 66–72.

[6] S. Borrás, J. Edler, The governance of socio-technical systems: explaining change, Edward Elgar Publishing 2014.

[7] J. Karjalainen, M. Käkönen, J. Luukkanen, J. Vehmas, Energy models and scenarios in the era of climate change, Finland: Finland Futures Research Centre, 2014.

[8] C. Dieckhoff, Modellierte Zukunft: Energieszenarien in der wissenschaftlichen Politikberatung, transcript Verlag 2015.

[9] S. Tuler, K. Dow, T. Webler, Thomas, J. Whitehead, Learning through participatory modeling: Reflections on what it means and how it is measured In: Environmental Modeling with Stakeholders, publisher =.

[10] J. De Kraker, C. Kroeze, P. Kirschner , Computer models as social learning tools in participatory integrated assessment, International Journal of Agricultural Sustainability, 2011 Volume 9 Nr. 2 pp. 297–309.

[11] B. Siebenhüner, B.Volker, Stakeholder empowerment through participatory planning practices: The case of electricity transmission lines in France and Norway, Environmental Impact Assessment Review, 2004, Volume 22, Nr. 4 pp. 367 – 389.

[12] S. Arnstein, A Ladder of Citizen Participation, Journal of the American Institute of Planners, 1969 Volume 35, Nr. 4 pp. 216–224.

[13] S. Alcántara, N. Bach, R. Kuhn, U. Peter, Demokratietheorie und Partizipationspraxis: Analyse und Anwendungspotentiale deliberativer Verfahren, Springer 2016.

[14] O. Renn, T. Webler, Der kooperative Diskurs– Theoretische Grundlagen, Anforderungen, Möglichkeiten In: Abfallpolitik im kooperativen Diskurs. Bürgerbeteiligung bei der Standortsuche für eine Deponie im Kanton Aargau, Hochschulverlag AG, Zürich, 1998.

....

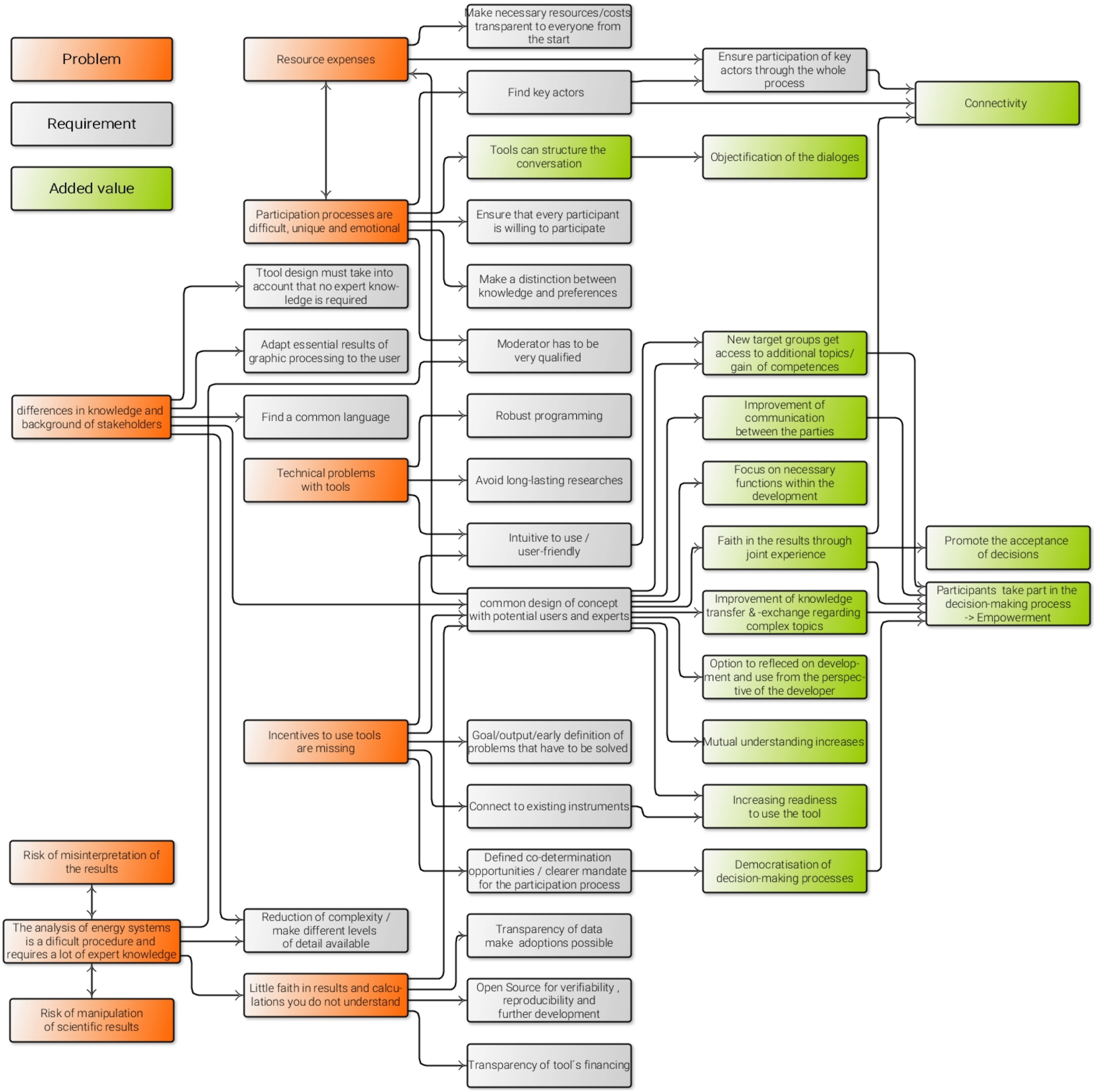

Figure 3: flow chart from StEmp Tool workshop (RLI EnergieDialog) Sept. 2017