''Only Social Scientists Laughed'': Reflections on Social Sciences and Humanities Integration in European Energy Projects

Post-Print version of
Sonetti, G., Arrobbio, O., Lombardi, P. Lami, I. & Monaci, S. (2020).
''Only Social Scientists Laughed'': Reflections on Social Sciences and Humanities Integration in European Energy Projects".
***Energy Research & Social Science*, 61, 101342.**
DOI: 10.1016/j.erss.2019.101342.

Abstract

This paper gathers reflections on what can bring together academics and practitioners involved in energy-related European Union (EU) funded projects aiming at, or striving to reach, higher integration of Social Sciences and Humanities (SSH) with Science, Technology, Engineering and Mathematics (STEM). To this end, four multidisciplinary workshops carried out in the EU Project `Social Sciences and Humanities for Advancing Policy in European Energy - SHAPE ENERGY- (2017–2019)' have been analysed in order to address the following questions: (1) Which STEM-SSH aspects are dealt with in EU-funded projects?; (2) Which tasks relate to SSH practitioners in the Work Packages distribution?; (3) How do EU-funded projects engage in interdisciplinary work?; (4) Which barriers for effective SSH integration have been envisaged?. The main findings emphasise how SSH is still predominantly regarded as a means to orient the market and encourage individuals to accept a top-down policy, technology or process, and this is further illustrated through the ways in which the Horizon 2020 energy and transport calls are fundamentally framed and positioned. Based on the research conducted in this paper, the four workshops represented the right approach not only for comparing current directions and ongoing tasks in individual EU energy and transport projects, but also for proposing concrete ideas to increase the impact of said projects on society. Moreover, this approach favoured reflections on innovative methods of interdisciplinary project ideas for energy-related topics. The conclusion of this paper gives suggestions on how to achieve better interdisciplinary practices when designing EU calls and projects related to energy topics, calling for further interdisciplinary and society-relevant research and innovation, through enhanced multi-stakeholder cooperation and interdisciplinary communication on complex topics.

1. Introduction

In recent years, the European Union institutions responsible for research project funding have been calling for better integration of Social Sciences and Humanities (SSH) in funded projects. Since their inception in 1984, European research projects have predominantly been Science, Technology, Engineering and Mathematics (STEM)-led initiatives. Their goal was to ensure European leadership [17] in Science and Technology and to improve the technological development of European industries. From time to time, some elements of SSH appeared, mainly to provide forecasting and assessment scenarios in technology market uptakes, and to inform policies [15, 16]. It was indeed the need for policy feedback that called for a wider and more complex analysis of the links between Science, Policy and Society, in particular when dealing with environmental issues. The Framework Programmes for Research and Technological Development, also called Framework Programmes or FPs (FP1 to FP8), are funding programmes created by the European Union/European Commission to support and foster research in the European Research Area (ERA). Although FP3 (years 1991–1994) contained some SSH research elements, it was with FP4 (1994–1998) that SSH research gained the status of separate research programme. The first signs of a real attempt to achieve interdisciplinarity can be found in FP5 (1998–2002). Even if there were no ex-post evaluation of the efficacy of SSH integration, research on that appeared as necessary and to be reinforced. FP6 (2002–2006) included an SSH research programme called `Citizens and Governance in a knowledge-based Society', aimed at improving the interdisciplinary research to be fed into public policies [47]. Moreover, the FP6 coordination of socioeconomic research and foresight elements across Science, Technology, Engineering and Mathematics (STEM) related projects. FP7 (2007–2013) tried to overcome the limited implementation of SSH in FP6: SSH was included in a new European Research Council (ERC) domain, with interdisciplinarity being deemed positive within the single domain but also across the different domains [11]. FP8 (2014–2020) - better known as `Horizon 2020' or H2020 - hails SSH as a cross-cutting dimension throughout the entire research activities, notably under the pillars `Industrial Leadership' and `Societal Challenges'. It reflects this policy priority addressing major concerns shared by citizens in Europe and elsewhere. Because global challenges are complex and `wicked', their solutions imply the transformation and creation of systems, instead of siloed and technocratic approaches [5, 26, 36]. A challenge-based approach brings together resources and knowledge across different fields, technologies and disciplines, including SSH [8]. Mission-oriented research and innovation initiatives must ensure that technologies are developed and deployed across sectors [22]. This covers activities from research to policy with a new focus on innovation-related activities, and support for user engagement and societal challenges, characteristic of SSH skills and tools [21]. This is why Horizon 2020 promotes interdisciplinarity in a significantly different way compared to previous EU FPs, since it blends the SSH across the entire framework, while in previous FPs the SSH was put in a dedicated research program [17]. While missions require expertise from different sectors and disciplines to come together, interdisciplinary research and collaboration can provide substantial benefits to scientists, practitioners and policymakers [29]. `Interdisciplinarity' is one of the trendiest words in research on contemporary energy. The propaganda and the fuzziness of the concept hides a great possibility for this kind of research: the opportunity of unfolding new perspectives, of finding new answers, but also of raising new questions [29]. Recently, a significant number of articles focused on the (re)definition of the terms `multidisciplinarity', `interdisciplinarity' and `transdisciplinarity' [40]. In this paper, we wanted to explore how this concept (intended by participants according to their views) was translated into concrete action in their EU-funded energy projects. Here, interdisciplinarity is taken as ``*[...] the combination of knowledges between the social sciences and the humanities (SSH) and the `natural' or `life' sciences in order to tackle societal and technological challenges that need to be integrated in a wider social, economic, cultural and political perspective which constrain technological development*'' ([17]: 43), without any distinction between multi-, trans-, and inter-disciplinarity. Current literature distinguishes different modes of collaboration among STEM-SSH [37, 38], ranging from attempts to integrate multiple disciplinary perspectives, and academic and non-academic stakeholders and to create new scientific models across different disciplines [33]. Furthermore, substantial empirical differences exist concerning the dispositions and strategies for engaging in interdisciplinary research [18] at an individual level. Theoretical languages, epistemic goals, strategies, formulation and coordination of research questions, and methodology constitute difficult barriers to overcome given the absence of a dedicated integration `guideline', while the timing of integration (initial problem formulation, proposal writing, ongoing implementation) and the modes of interdisciplinary collaboration (frequency, scale, duration) still constitute barriers for an effective STEM-SSH integration. Moreover, funding for interdisciplinary research requires that policymakers and members of the scientific community move beyond simplistic notions of interdisciplinary collaboration [6] and create appropriate indicators for measuring their effectiveness [3, 4]. Understanding the empirical richness and different scales, modes and temporalities of interdisciplinary research will lead to a more comprehensive model for stimulating integrative environments than the one currently adopted by leading funding agencies. Learning how interdisciplinarity works in different communities, contexts and sectors will also help widen the understanding of how research impact is achieved in different interdisciplinary settings and how it can be better framed in EU policy calls [44]. In the conclusion of his work, Keraudren draws two main conclusions for progressive interdisciplinarity in future EU policies: the first and obvious one is that, in order to succeed, interdisciplinarity must have a long-term policy. The role of the European Commission in this regard, as any funding agency, is crucial [20]. The second conclusion aims at overcoming the `two-stages' policy of separated SSH and STEM calls. The EURAB report also recalls that ``*[...] European Social Sciences and Humanities are world class, especially considering their diversity. They are indispensable in generating knowledge about the dynamic changes in human values, identities and citizenship that transform our societies. They are engaged in research, design and transfer of practical solutions for the better and sustainable functioning of democracy*'' ([7], p.25). The debate is therefore open and deserves to receive more contributions as Horizon 2020 unfolds and implements its new approach. Above all in the energy sector, cases like the rebound and `prebound' effect [12, 42] call for more social variables to be displayed by researchers for more effective energy consumption policy assessments. These are the premises of the `Social Sciences and Humanities for Advancing Policy in European Energy' - SHAPE ENERGY-project, a 2 million Euro investment through the EU Horizon 2020 programme (2017–2019). It aimed to include a multi-interdisciplinary space for discussion of new questions that challenge the status quo on energy-SSH integration. Since the bias towards asking and answering questions that fit the current political and social direction can be limiting, `blue-sky' thinking among disciplines is considered valuable to this end. The multidisciplinary workshops, also called sandpits, were part of these `free-mind' brainstorming activities aimed at developing Europe's expertise in using and applying energy- SSH to accelerate the delivery of an interdisciplinary European Energy Union Strategy. Storytelling has been used to obtain empirical material useful for carrying out the analyses on the blue-sky exercises made in the sandpit framework. Four Horizon 2020 sandpits brought together 75 participants from 17 countries and 36 EU energy-related funded projects (listed in Table A1 in the appendix). Using storytelling methods as described by Mourik et al. [25], the sandpits aimed at building the participating consortia's collective ability to understand how EU-funded projects are thinking of integrating SSH in energy-related topics. The sandpit process, along with the selection, description of participants and delivery of the sessions, is showed in Par. 2. Par. 3 depicts the findings along four different answers to the questions: (1) Which STEMSSH aspects are dealt with in EU-funded projects?; (2) Which tasks relate to SSH practitioners in the Work Packages distribution?; (3) How do EU-funded projects engage in interdisciplinary work?; (4) Which barriers for effective SSH integration have been envisaged?. The concluding discussion on how to obtain better interdisciplinary work both when designing EU calls and in designing projects related to energy topics, calling for further interdisciplinary and society-relevant research and innovation, are presented in Par. 4.

2. Methodology

As with data collection, the analysis of qualitative data can take a range of forms. Here the most structured approach is content analysis, which involves coding samples of interview or focus group transcripts, documents and communication records with the aim of systematically identifying categories, themes and patterns and reporting these numerically or graphically. Content analysis is most useful for studies that start with a clear theoretical framework or set of expected categories. However, it is not always effective for richer, deeper analysis or narrative description. Richer analysis can be achieved through narrative analyses which seek to analyze text or utterances with the aim of identifying `storylines' that particular actors or groups use to frame (i.e. perceive and/or communicate about) a topic or experience. The objective here can be interpretive, or explanatory in the sense of linking cause and effect. Narratives can be identified at an individual level (e.g. how consumers explain their purchasing behavior), or more broadly for formal or informal social groups (e.g. how oil companies respond to `attacks' from environmental groups). Qualitative research methods differ according to the nature of data collection, as well as the means of analysing that data. In energy social science, the most popular approaches to qualitative data collection tend to be semi-structured interviews, focus groups, direct observation, participant observation and document analysis, which the case of the sandpits collect them all [49]. Among qualitative methods for research design, sandpits are gaining ground as useful events to promote creativity and foster new ideas around a specific issue [2]. Sandpits are interactive workshops normally involving 20–30 participants, a director, a team of expert mentors, and several independent stakeholders. Sandpits usually have a highly multidisciplinary mix of participants, some active researchers, and other potential users of research outcomes, whom all come together in pursuit of lateral thinking and radical approaches to research challenges [14]. Conceived as moments of cross-disciplinary brainstorming, where groups of academics and practitioners gather in the same place for a couple of days, four sandpits were organised in Turin (Italy) in February 2018 with 75 practitioners and researchers representing institutions from 17 different countries: Belgium, Croatia, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, the Netherlands, Norway, Portugal, Slovakia, Spain, and the United Kingdom. Their disciplinary background was distributed across STEM (approximately two-thirds) and SSH (approximately one-third). The above-mentioned sandpits, called `From Horizon 2020 towards FP9 interdisciplinary projects: be amazed at what we can achieve together!', were dedicated to the issue of integrating Science, Technology, Engineering and Mathematics (STEM) with Social Sciences and Humanities (SSH) in EU-funded energy and transport projects. They were meant to promote intensive discussion forums, where freethinking was encouraged to delve into problems and explore innovative solutions concerning EU energy policy. The sandpits took place at two different times, each one dedicated to two of the following four topics: 8–9 February 2018: Topic 1 `Energy efficiency and using less' and Topic 2 `Competitive, secure, low carbon energy supply'; 22–23 February 2018: Topic 3 `Energy system optimisation and smart technologies' and Topic 4 `Transport sector decarbonisation'. In the following sub-section, the design and implementation phases of the sandpits are described. These include the creation of the EU project database, the sandpit participant selection criteria, participant facts and figures, and activities carried out at the Politecnico di Torino location (storytelling, visual thinking, social dinner, and visit to the UNESCO world heritage site). All our sandpit planning was done to create a stimulating environment and to share new and novel ideas with the intention of fostering future collaborations.

2.1. The selection process

In the months from March to May 2017, a database of more than 500 Horizon 2020 and FP7 energy and transport projects were set up. These projects were selected according to their relevance to the aforementioned four topics. The projects were chosen according to the following procedure: On the freely accessible CORDIS EU portal, keywords associated with the four topics were used to find potentially relevant EU projects. In order to limit the research in such a way as to be as relevant as possible to the aim of the sandpit, we did a cross-search based on different keywords such as `energy', `inclusive', `transport', `energy supply', `low carbon energy', `secure energy', `competitive energy', `sociology', and `humanities'. Afterwards, a project-by-project examination was carried out to identify all those potentially relevant projects; thereby, we eliminated off-topic projects (such as, for example, Marie Curie projects that were solely mobility-focused projects, or solely technical projects that dealt with research infrastructures that do not concern energy-SSH interplay). Finally, all our shortlisted projects were reviewed to eliminate those for which we did not have significant and critical details (e.g. coordinator contacts) to be useful for project database completion. This led to a list of mostly Horizon 2020 projects, with some FP7 ones, too. In creating a final list of EU projects, only projects that had their final year from 2016 onwards were included to ensure that there was maximum scope for us to potentially influence how they accounted for SSH in the final and follow-on stages of their projects. Invitations to apply were sent to the coordinators of those ~500 projects from late October to early November 2017. Herein, project coordinators were asked to make their partners aware of the opportunity to apply for the sandpits. They were also told that the sandpits were intended for three or four members of each consortium (from at least two different partners) to attend and that preference would be given to consortia for whom this was the case. However, applications were also welcomed for projects with just one partner/individual interested in attending. They were asked to indicate the topic(s), and thereby sandpit date, they would have liked to attend.

In the invitation to the project coordinators, the following opportunities for participants were emphasised:

• reflect on current project direction and tasks, and take inspiration from each other on ways to tackle or innovate them;

• generate and discuss future project ideas with current and potential partners, in light of the latest Horizon 2020 funding calls;

• experience innovative methods of interdisciplinary and cross-sector work (such as storytelling), through workshop sessions;

• consider the integration of different disciplines within energy and transport projects, including the challenges and successes in this area;

• generate concrete ideas to increase the impact of one's own projects;

• meet cross-European collaborators in a stimulating environment, through dedicated networking sessions; and

• spend quality time with a few key partners in their current consortium.

Call for applications officially closed on 22 November 2017. Preference was given to consortia with the highest number of representatives interested in attending the sandpits. Secondarily, we preferred the projects where individuals came from under-represented countries.

2.2. Participants at the sandpits

In the following subsections, a detailed overview is provided of the sandpit participants, Horizon 2020 projects, topic alignment, gender, and country location of their research organisation. As is detailed, STEM disciplines were more represented than SSH disciplines, men were more represented than women, and Eastern Europe organisations were less represented than other regions of Europe. While the first two aspects may be, at least partially, explained by the current disparities related to funding processes and female underrepresentation in the energy sector [1], the latter – for lack of better explanations – may in part be due to logistical aspects. Despite all this, we found no evidence that the slightly uneven representation of European geographical areas impacted significantly on the work carried out during the sandpits. The representatives of 36 projects (at the end, all of which were Horizon 2020 projects) were present at the sandpits. Names and titles of the projects can be found in the Appendix. STEM representatives were consistently more numerous than SSH representatives. A breakdown of this balance can be found in Table 1. A similar breakdown concerning the number of participants per project is provided below in Table 2. Two projects (AMBITION and SHAPE ENERGY) were represented at both events. For them the total number of participants to the sandpits was six and seven respectively, thus representing 8.0% and 9.3% of the total participants. The sandpits had higher male (50 participants out of 75; 66.7%) than female (25 participants out of 75; 33.3%) participation (Fig. 1), with the most eccentric value concerning this aspect being related to Topic 1 (female participation at 39.1%). Whilst various studies have noted how women engage more in interdisciplinary research collaboration [30, 32, 44], we do not have enough evidence here to support this claim either way. Perhaps it could be due to the overall success of the facilitation methodologies used in the sandpits (which saw no significant difference in engagement between males and females). However, we do recognise the persistent lag faced by the underrepresented minority of women in STEM fields [46]. In terms of the countries where participants work – or, more precisely, where participant organisations have their primary or secondary offices – Italy was most represented with 25 participants out of 75, of which: seven from the Politecnico di Torino; five from other institutions based in Turin or in the Metropolitan City of Turin; seven from the neighbouring regions of Lombardy and Liguria; and six from other regions. All European geographical regions were thus represented. Due to the high presence of Italian organisations, the majority of participants came from Southern Europe, while Eastern Europe organisations were the least represented.

2.3. Delivery of the sandpits

As in many other scoping activities delivered by SHAPE ENERGY– e.g. multi-stakeholder workshops in cities across Europe, an Early Stage Researcher programme – the storytelling technique was utilised [9, 23, 25]. While multi-stakeholder working techniques are often developed from SSH, learnings from those experiences are not easily applicable in many cases [48]. One such technique is storytelling. In this paper, we define a story as being a purposefully `emplotted' account (following a plot or `story spine') of a sequence of events (which does not have to be chronological) and the principle of cause and effect. Storytelling methods (and narrative-based work more generally) are seen to offer a valid route to both understandings and communicating real-life (necessarily subjectively interpreted) experience [23], which after all is the context in which energy transitions must ultimately take place. In the sandpits the storytelling technique was adopted to emphasize the performance, and the elicitation and construction of stories or narratives – both in oral and written form - in a particular context such as the sandpits [23]. From this perspective, the `same' story may be told or written quite differently from one instance to another, even by the same teller, challenging the notion of stories as stable data points. In the end, this characteristic of storytelling enhanced rather than discouraged the richness and the diversity of the individual opinions in the sandpits. Storytelling involves communicating in a way that emphasises plot, characters, and narrative, and is an instinctive form of talking or writing which humans have used for centuries to transfer essential life lessons or for other learning purposes [13, 19, 24]. Precisely for these sandpits, the storytelling was adapted to engage diverse project stakeholders, acting as a bridge between different expectations as well as between different degrees of willingness to contribute to the sandpit activities. This means that more than a proper `fictional' character in an original setting, we used the structure of a story (the story spines presented in the appendix) to let the participant speak about some methodological aspects of SSH integration. The textual materials (story spines) and the audio-recordings have been analysed through an interpretative and qualitative approach based on grounded theory [50] aimed at identifying thematic categories and aggregations coherent with the four research questions posed by our study. The qualitative and interpretative approach is particularly suitable to analyse - according to an empirical sociological perspective - small samples of sources such as textual or visual contents or transcriptions of interviews or audio recordings. Notwithstanding their limited number (47), we assumed in fact that the stories reflected the positions and the perspectives of the sandpit participants considered as qualified testimonial on the topics (and practices) investigated. In the first phase, we mapped the materials outlining a first set of thematic categories (see Section 3) which were successively aggregated into a smaller number of categories. The main findings coming from the analysis/categorisation process are detailed in the following section. All the sessions in which the writers exposed their story to the public as products of the storytelling activities were also accompanied by realtime graphic illustrations (Fig. 2) to help interdisciplinary communication. To this end, the exercises proposed to the group during the icebreaking prepared the basis for a more sincere reporting of the stories and increased awareness of the importance of interpersonal connections, as confirmed by participant feedback and relevant literature on the topic [28, 34, 39]. Through the mechanisms and principles of theatrical improvisation, the participants were involved in a game in order to make contact with others in the group, to get to know each other and to tell one another about oneself more freely. Our intention is that in this blue-sky sandpit experiment, along with the storytelling, the impro-theatre exercises, the use of hands and heart in collaborative multi-stakeholder moments of free co-creation, the dialogue-walk across arts and food experiences, the real-time graphic illustrations and all the other tools we explored, can help to trigger more research on how to make inter and trans disciplinary work happen.

Table 1
Breakdown of science, technology, engineering and mathematics (STEM) and Social science and humanities (SSH) participants per sandpit topic.

Topic no.	Topic	No. of STEM participants	No. of SSH participants
1	Energy efficiency and using less	14	9
2	Competitive, secure, low-carbon energy supply	14	6
3	Energy system optimisation and smart technologies	12	5
4	Transport sector decarbonisation	10	5

Table 2
Sandpit participants per Horizon 2020 energy and transport project, summed across all topics and both sandpit events.

Participants per project	No. of projects	% of total projects	No. of participants	% of total participants
1	15	41.7	15	20.0
2	11	30.6	22	29.3
3	7	19.4	21	28.0
4	1	2.8	4	5.3
5	0	0.0	0	0.0
6*	1	2.8	6	8.0
7*	1	2.8	7	9.3
TOTAL	36	100.0	75	100.0

* Project with representatives at both sandpits dates.

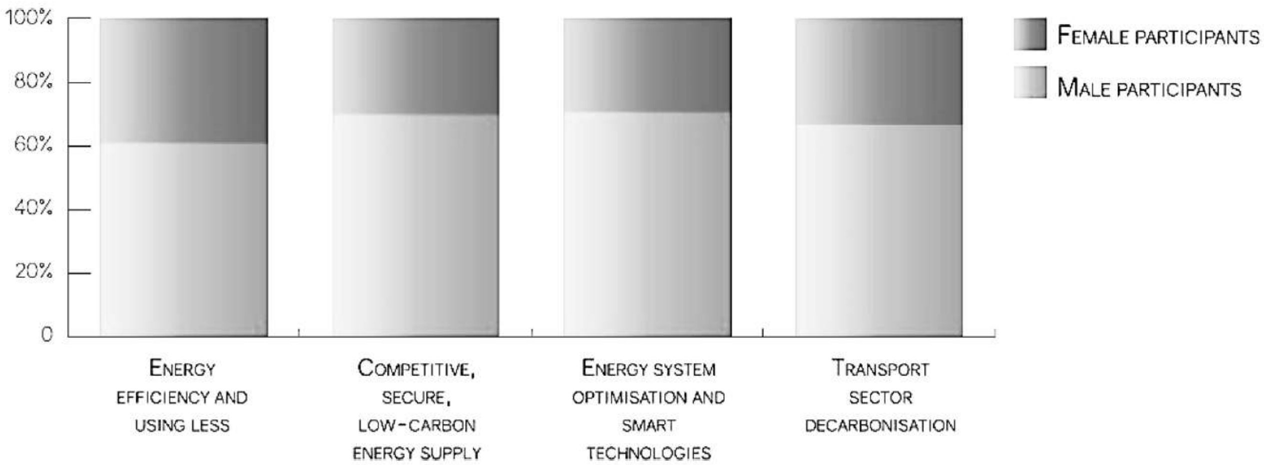

Fig. 1. Percentage of male and female participants working across the four topics at the sandpits ($n = 75$).

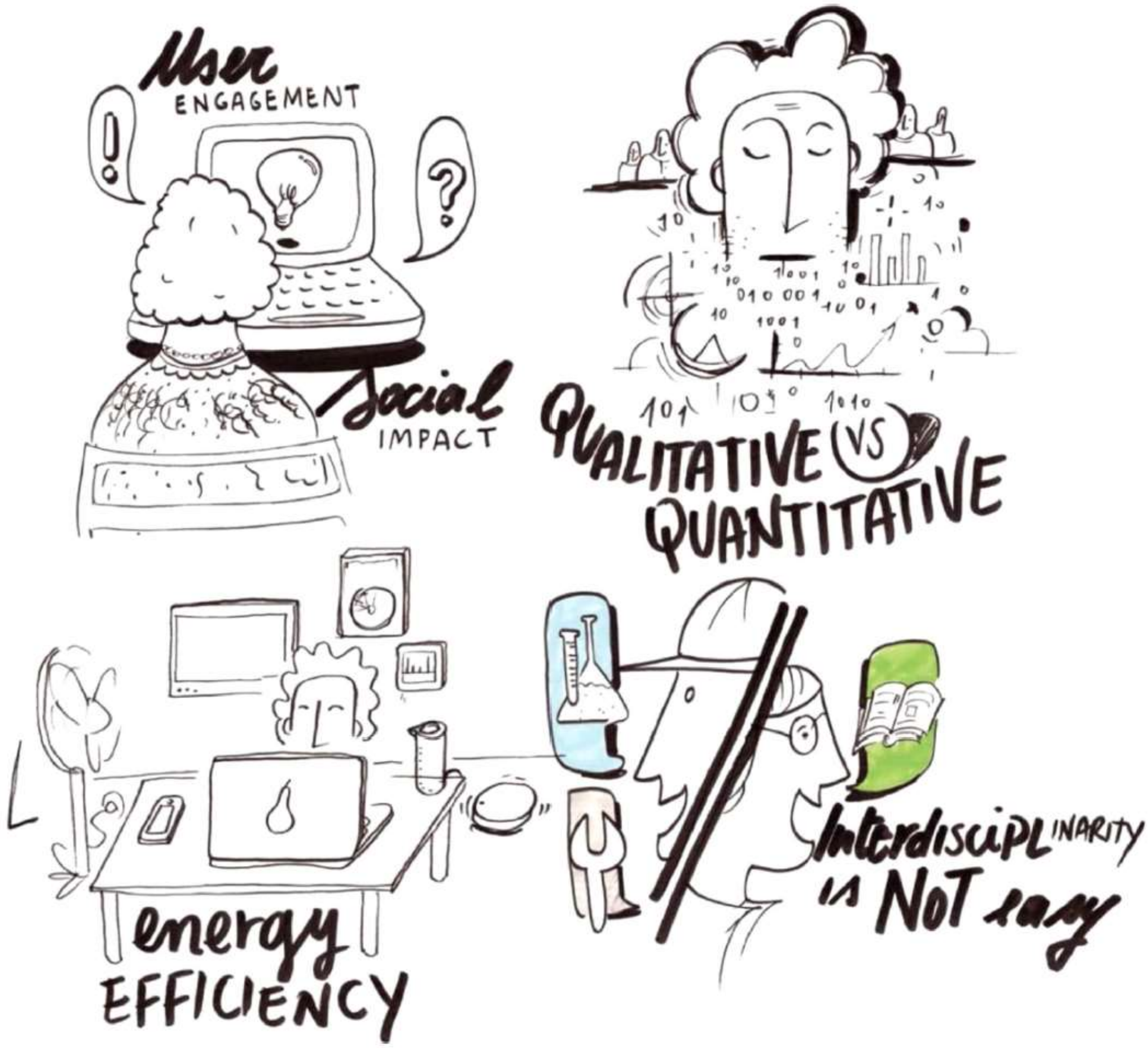

Fig. 2. Some of the real-time graphics illustrations made during the sandpits by http://rubrastudio.com/.

3. Findings

This section aims at summarising (predominantly through thematic categories and aggregations) what emerged from the empirical materials collected during the sandpits. These were, namely: the story spines compiled during the first days; the final proposals produced by participants during the second days' exercise; and the audio recordings of the final plenary sessions when the final proposals were presented and discussed also with guest panellists. Through the story spine form used during the first day of the sandpits (Figs. 3 and 4), participants were asked to describe their projects' objectives, and we collected a total of 47 `energy stories'. The represented projects offered a wide variety of aims, which made categorisation challenging to achieve. It should be kept in mind that the project descriptions that participants provided may differ from the descriptions that would have been delivered by the other partners involved in those projects. Moreover, we are not attempting to be representative of the experiences of all projects involved – instead, we offer indicative and illustrative insights with the hope that they will trigger a broader debate and reflection on the role of SSH in interdisciplinary energy projects and related proposals. Participants were asked to sign a Non-Disclosure Agreement, to ensure the confidentiality of current project outputs – as well as of new project ideas – among attendees. In compliance with this Agreement, the findings will be described on an intentionally generic level and with no specific reference to the projects they relate to. The main question throughout the sandpits was how, and if so to what extent, SSH disciplines could interact with STEM-led project expertise. 75 participants from 17 European Countries gave hints following four questions: (1) Which

STEM-SSH aspects are dealt with in EU-funded projects?; (2) Which tasks relate to SSH practitioners in the Work Packages distribution?; (3) How do EU-funded projects engage in interdisciplinary work?; (4) Which barriers for effective SSH integration have been envisaged?. In the subparagraphs below, we present and discuss the outcomes of these four prompts, recalled by their numbers and summed up in Table 3.

SHAPE ENERGY H2020 Sandpits

8th-February 2018

Story Spine 1 - Topic 1

YOUR NAME

YOUR SCIENTIFIC SECTOR

1) A few years ago I/we became part of a EU funded consortium (please tell us the name)

2) that wanted to tackle the topic of "Energy efficiency and using less" and I/my organisation joined because (describe what the promise of this project was for you/your organisation)

3) Us (describe your disciplinary background) ... researchers really wanted to work on ... (describe the research questions you wanted to tackle) ...

4) But, other (SSH) disciplines were involved as well, and to them the most interesting research questions with respect to our topic was ...

SHAPE ENERGY SOCIAL SCIENCES AND HUMANITIES FOR ADVANCING POLICY IN EUROPEAN ENERGY

5) So, we discussed that (discuss which (SSH) disciplines and expertise were necessary), and that to make sure we used all of them (discuss how you collaborated) ...

6) Then we were able to worked together towards reaching (name the EE impacts (strategies / policies / technological solution that you developed with the project) ...

7) What we learned from this is ... (discuss what lessons on interdisciplinary working and on the use of SSH came out of the project)

8) Thanks to this collaboration we came up with knowledge and had impact that we otherwise most likely would not have achieved, such as (describe what came out especially from this interdisciplinary working if you had such collaboration; if not, then describe what you might have achieved if you had had SSH disciplines in your project working together with the other disciplines)

9) But we are not finished yet! We need to continue working on (describe what impacts, policies, strategies etc are necessary to reach the Energy Efficiency First principle) ...

10) And to be successful at that, we need to overcome ... (name the barriers and other issues that need to be solved or addressed in a next consortium/EU project)

SHAPE ENERGY SOCIAL SCIENCES AND HUMANITIES FOR ADVANCING POLICY IN EUROPEAN ENERGY

Fig. 3. Story spine used in the first day of the sandpit.

3.1. How are STEM-SSH aspects dealt with in EU-funded projects objectives?

The 47 `energy stories' collected in the four sandpits mainly focused on STEM projects related to fields as diverse as: the development of more efficient or new energy conversion devices, production devices and distribution systems (e.g. fuel cells, hybrid systems, microturbines, smart grids, energy storage, CO_2 capture, new materials, nanoparticles, frac-fluids, renewable energy production from waste, internal combustion engines); the integration of bioenergy generation with wind and solar energy; cloud infrastructures for energy-related data. Projects had among their objectives: testing and offering new engagement methodologies and techniques; the study of trust within energy socio-technical systems; a better understanding of user perceptions and behaviours; the analysis and understanding of narratives, as well as of the social and policy mechanisms fostering or hindering the energy transition. Other aspects were related to organisational techniques and to issues related to the relationships of human actors with specific technical objects or apparatuses: user segmentation to improve the adoption and impact of feedback solutions; bridging the gap between market and research (e.g. business models, valorisation and market uptake of specific technical solutions). When referring to the (1) prompt, the SSH aspects of project objectives were described as mainly being used for theoretical approaches in the engagement of stakeholders, increasing local authorities commitment with the energy transition, and understanding critical motivational factors for stakeholder engagement in the use phases of their services/products. As such, STEM-based projects representatives were keen for SSH to `service their needs' so to speak, as part of delivering on their broader ambition of diffusing their technology more widely across societies. Implicitly – and, at times, explicitly – this diffusion seemed to occur in two ways: one was via direct market access, requiring Economics and Business Management research as an evidence-base support for their roll-out; the other was via blocking the market or at least overcoming the market challenges driving individual choices, using SSH disciplines to inform `awareness-improving' activities. The foci/units of their interventions and analyses were therefore usually end-users and sometimes also policy-makers, but only in respect of policy-makers being the route by which end-user behaviour could be changed. Marginal attention emerged about key sociological aspects such as ``*understanding key motivational factors for long-lasting behavioural change'' or ``understanding social and policy mechanisms fostering/hindering energy transition*''. Even if those issues could give extremely significant insight into the root-causes related to social dimensions of the energy transition process, they probably were overshadowed by knowledge and data that could be much more easily operationalized into practical actions in the context of the different projects.


SHAPE ENERGY H2020 Sandpits

9th-February 2018

Story Spine 2 - Topic 1

YOUR NAME

YOUR SCIENTIFIC SECTOR

My future energy efficient and using less story

1) Title:

2) I/we dream of a future where a typical day will look like this ...

3) To solve the challenges envisaged in the just presented H2020 topic, many actions will be undertaken ...

4) And the following social science and humanities research will prove to be particularly valuable to achieve the change:

5) This research will have a big impact because ...

6) What I plan to do every day to make my story happen ...

SHAPE ENERGY SOCIAL SCIENCES AND HUMANITIES FOR ADVANCING POLICY IN EUROPEAN ENERGY

Fig. 4. Story spine used in the second day of the sandpit.

3.2. Which tasks were given to SSH disciplines?

The description of the roles that were (or could be, or should be) given to SSH in the represented projects can be grouped according to the following categories: Business studies and economics; Acceptance; Communication; Engagement; Behavioural change. All of these tasks were found to be present (or deemed useful) at all projects phases, or even before or independently from the projects themselves, as a prerequisite for the establishment of more favourable and welcoming markets and policies. A cross-cutting or undefined `Understanding' category can be added to the categories mentioned above, which encompasses something which is needed to improve the efficacy of all the others. Only in a very few of the represented projects did no integration of SSH take place, as the following sentences show: ``*Unfortunately, no SSH disciplines were directly involved. However, the project has an impact on society because one of the goals is the reduction of [pollutant name] emissions*''; ``*Not directly (very focused on RIA). However, all partners and project consortium had to explain to the public why [name of the specific technological option the project was about] is required*''. It thus seems that the representatives of these projects somehow felt the need to display sorrow or to give extenuations (which nevertheless demonstrate that the meaning of `SSH' was stretched out to include something that SSH do and the impacts on one of the objects of their activities) for the fact of not having integrated SSH into their projects. In (2), participants were asked about other disciplines that were involved in their projects. In particular, if other SSH disciplines were thought to have a role in the subsequent steps of their project, or future follow-up proposals and projects. Interestingly, responses were very much dominated by STEM-led terms of reference, which subsequently positioned SSH as having a very particular (and usually instrumental) `offer' to neatly answering STEM-led questions. This was especially clear when hearing from STEM projects that had been confidently developing new or improved technical objects or processes. For instance, despite the evident improvement these objects and processes may represent and the benefits that they may thus bring, none had yet found a market. While this should not be a surprise given that these Horizon 2020 projects primarily concern technology development and initial exploratory implementation plans, it is certainly interesting to note that SSH was viewed as the mechanism by which these newly developed technological solutions could `achieve scale' across the European market. Those shreds of evidence are referred to in many comments given by participants such as ``*the formulation of business cases about the future deployment of such technologies at the large scale*''; ``*economics studies*''; ``*develop a business model and plan for the companies that sell metering and management services to energy utilities*''. Other comments refer to the ``*social acceptability of this technology in terms of safety*''; ``*to increase the acceptance of [kind of energy source] as an energy source*''; ``*how to ensure a positive public perception about [field of intervention of the project]*''. The evidence reframes the involvement of SSH as a possible means for shaping social perceptions and fostering acceptance rather than a useful means for critically addressing the social needs and obstacles to the energy transition.

Table 3
Research questions and answers from the four sandpits qualitative data analysis.

Research questions	Categories	Main sub-categories/examples	Matches with the literature review
Which STEM-SSH aspects are dealt with in EU-funded projects?	STEM aspects	Development of more efficient, or new, energy conversion devices, production devices and distribution systems; Generation, storage, management and visualisation of energy-related data.	[51] [48])
	SSH aspects	Stakeholders and users engagement and commitment; Consumers awareness and Behavioural change; Users practices (related to energy and technology use); Users trust; Transposition of legal aspects; Policy mechanisms; Narratives analyses.	[9]
	Mixed	Organisational techniques; Issues related to the relationships of human actors with specific technical objects or apparatuses.	[52]
Which tasks relate to SSH practitioners in the Work Packages distribution?	Business studies and economics	Business and financial market models; Demand management; Service and product design; Market research.	[53]
	Acceptance and engagement	Strategies to convince people; Aesthetics improvements; Safety and salubrity issues; Citizens and stakeholders acceptance; Citizens involvement.	[10][51]
	Communication	Communication with citizens; Communication with local stakeholders; Communication with customers/clients;	[54][55]
	Behavioural change	Shifts towards more responsible and rational consumers behaviours; Behavioural modelling.	[56]
	Increasing understanding	Effect of communication with local stakeholders; Effect of technical improvements on `social' aspects; Understanding local cultures and social structures; Incorporate people needs and skills in designing solutions; Provide the basis for more stringent regulations (e.g. on emissions).	[57,58]
	No integration	–	[33]
How do EU-funded projects engage in interdisciplinary work?	Internal organisation	Inter- Multi-disciplinary more or less structured workshops aimed at revising or discussing the workplan; Find a common language/understanding (at least for some specific actions); Mutual training; Setting up a complementary structure of tasks; Joint use of both quantitative and qualitative methods.	[38]
	External input	Internships; Support (more or less formal) from external experts.	[40]
Which barriers for effective SSH integration have been envisaged?	Recognising the importance of the `human' factor	Technical improvements alone are not effective or sufficient; Users/behaviour awareness campaigns should be given a more central role; Recognising `social' barriers.	[59,61]
	Interdisciplinary work	STEM practitioners need to understand the effectiveness of multidisciplinary work including SSH; Wide gap in background, lexicon, theoretical framework and methodologies among and within disciplines; Sharing common perspective, objectives and visions about specific issues; `Siloed' mentality; Need of better communication skills.	[33]
	People involvement	Experts knowledge is not sufficient; People are not enough aware and/or have selfish objectives; Innovative engagement methodologies are needed; People have to be involved from the beginning	[18][60]
	Regimes/narratives and policy	Incumbent industrial/political players prevent narratives to change; Incumbent technological players create strong barriers to specific technological development; Inadequate mechanisms and frameworks; Give policy makers the means to justify policies in front of their voters.	[62–64]
	Data privacy issues	Data privacy protection issues.	[65]
	Funding and economic issues	Lack of financial support from EU commission and governments; High cost of some technologies/measures.	[52]

3.3. How has interdisciplinarity been dealt with (or how could it)?

With the exclusion of a few projects which had not dealt (or had not yet dealt at the time of the sandpits) with interdisciplinary actions, the others can be divided into two groups: those that relied on resources which were external to the projects' consortia and those that organized activities and exchanges among partners having different expertise and competencies. With regard to external input, solutions comprised: internships with two SSH researchers who had to transform project results into ```tips' for the decision makers''*; support from applied anthropologists to overcome language barriers between engineers and computer scientists on one side, and end-users on the other side; discussions with sociologists and other experts to understand how societies can come to use less energy; collaboration with economists and business experts to better define the price of the product developed by the project. With regard to internally-organized activities, solutions comprised: the organization of workshops among *``the disciplines to discuss the structure of the work plan and to reflect on outputs''*; *``long process at the beginning of the project''* to ``find a common language and understanding''; not clearly defined *``exchanges between Work Packages''*; setting up of a clear division of labour related to methods (qualitative/quantitative) or disciplines (*``Economists: social responsibility of companies/public acceptance strategies (company side). Sociologists: public engagements & acceptance strategies (Public Administration side))''*; internal discussions *``to make sure we build a multidisciplinary team to tackle all aspects''*. As for (3), methods for interdisciplinary work were related mostly to dedicated workshops between the different disciplines in the same work package, for agreeing with work package goals and results and for finding a universal language. For others, interdisciplinarity happened when exchanging different STEM experts between work packages, and when discussing the social acceptance of specific technologies/products, also collaborating with local communities. Other projects resolved the need for interdisciplinarity calling an external help, either in the form of an internship or through a temporary contract with SSH specialists (applied anthropologist, sociologist, economist) and legal assistance for agreement and document writing. One participant referred the willingness to having more communication experts in the team but that no budget was allocated for that task. As a result, interdisciplinarity emerged as an essential dimension, either when considered as an external asset and as an internal asset of the project. The need to discuss social acceptability, the purpose of finding a common lexicon among STEM and SSH researchers as well as the opportunity to combine quantitative and qualitative methods arose as the main topics referring to interdisciplinarity. A further investigation would be necessary in order to assess if the interdisciplinary practices mentioned above would have been envisaged at the beginning of the project or included in a subsequent phase.

3.4. Barriers to be overcome

In the final part of the story spine form (4), participants were asked to identify barriers and other issues related to the integration of SSH that they felt needed to be solved or addressed in their current or future consortium/EU project. The most important factors that were identified can be categorized as follows: the need to recognize the importance of the `human factor'; the difficulties of interdisciplinary work; the role of policies, narratives and socio-technical regimes. With regard to the first one, it was stressed on the one side that higher efficiency or more generally technical measures alone do not necessarily bring energy savings. Insufficient consideration of the `human factor' (e.g. behaviours, practices, acceptance) may come to represent a decisive obstacle and a cause of failure for many projects. This would bring to the need of a higher involvement, as well as of a greater understanding, of (non-expert) people as well as of communities from the starting phase of projects (or even before) through innovative and effective methods and through the application of better communication skills. This is linked to the second aspect, which recalls the difficulties of interdisciplinary work. These were identified as being due to: `hard scientists' and engineers who do not recognize the need and effectiveness of multidisciplinary work; the `siloed mentality', which takes place even among practitioners and researchers of the same disciplines and which also affects SSH practitioners themselves; wide gaps in background, lexicon, theoretical and epistemological frameworks. All of these bring to the need, identified by participants, to *``be in the same room sharing a common objective''*, to have specific activities of *``mutual training and warm-up meetings among technicians and SSH''*. The intervention of the political and policy level was required, first of all, to give more financial support to interdisciplinary work, but also to adapt the regulatory framework to the needs of the energy transition (e.g. mechanisms to promote self-consumption). Finally, barriers were also identified in the power of the *``incumbent industrial/political players who drive specific narratives that prevent the changes needed''* in both behavioural and technology development. While analysing the stories, SSH researchers seemed to be willing to overcome the feeling of being mistreated by STEM researchers and practitioners. Moreover, challenges would lessen for SSH researchers if their perspectives could be integrated from the very beginning of a project, and not directly brought in when the project ends to achieve, for example, funder compliance or to `ensure' market uptake/acceptability (see also [35]). Moreover, a much broader engagement of `people' was advocated by many participants as an integrated part of the project. Participant comments such as ``*contextually deep understandings''; ``people have to be involved from the beginning''; ``engagement of citizens in the transition to sustainable and low carbon societies and in the planning and creation of energy communities [is needed]''* highlight the need for a more comprehensive concept of engagement which may also profit the initial phases of the project. In order to achieve such a shift in project design and implementation, language-related difficulties were also raised as a common barrier (in both directions) – particularly in terms of fundamentally defining the core problem that is to be investigated/targeted [10, 43]. The second day of each sandpit was devoted to an exercise focusing on answering actual energy or transport-related Horizon 2020 calls. Divided into groups (nine over the two sandpits), participants tried to imagine how SSH could play a more consistent role. To a great extent, the actions that were proposed (with some similarities – as well as peculiarities – among groups) took advantage of the many opportunities and obstacles we listed above. Participants undertook these funding proposal exercises with the understanding that it would have been impossible to have ready-for-competition project proposals in the end. However, all participants (panellists included) nevertheless invested considerable effort and energy into collecting and coordinating all possible inputs. Quality presentations and detailed structures of work packages and tasks were, in some cases – and despite the time constraints – impressively delivered by participants. A few further points should be noted: 1. All projects proposals tried to engage endusers/ citizens. It was not strictly required, as not all SSH play on that field; however, this was probably the way participants felt they could more intensely (and, likely, conventionally) showcase the integration of SSH. Indeed, the social organisation of other actors, such as policyworkers for instance, was very rarely considered, if at all. 2. The nine groups had a mixed SSH-STEM composition, with the only exception of two groups. One of them was composed of STEM practitioners and researchers only; the other one was `ruled' by the SSH majority, who `set the agenda'. The group composed of STEM practitioners and researchers complied with the task of imagining a project entirely reliant on SSH (all the `mixed' groups did too, even if this was more focused than the others on the importance of price signals for presumably rational users and even if they defined interviews and surveys as ``*nontraditional actions*''). The other group led by SSH practitioners and researchers performed the same task somewhat differently. The SSH practitioners and researchers endeavoured to go beyond the call, by trying to `fix' (using solely their SSH insights) the technical flaws and the subconscious or unquestioned ideological frame which brings people to be mostly seen as users instead of citizens. In that case, the exercise was not aimed at answering the call, but rather at improving the call. 3. The discussions were centred on the somewhat simplistic ideas related to how human agents behave and interact. Human agents are seen as rational actors, who operate in a social vacuum and who belong to communities that only come to life thanks to social media applications. At times, people are very well informed; at others, they are very severely aware and unable or unwilling to be guided by rationality instead of by habits or instincts. In any case, they are open to becoming recipients of ever more conspicuous information flows. Interestingly, when writing stories of future projects to exercise interdisciplinarity simulating an answer to actual Horizon 2020 calls, not one participant questioned the increased presence of ICT, and therefore of society's, enhanced connectedness, for example. It is thus implicitly clear that all the futures that were imagined in the exercises were connected futures [31, 41, 45]. This was especially evident in the exercises relating to the transport sector, where users were imagined as being able to optimize, via ICT devices, their mobility continuously. These assumptions were criticized for many reasons: because they are wrong or dated; because others proved to be more valid or promising; because they only represent particular disciplines or schools within disciplines. Maybe some of the most compelling evidence of the current difficulties of interdisciplinarity can be found in the following sentence. Taken from our notes and reports is the transcription of a sentence followed by the description of other participants' reactions: `` *[…] we social scientists have a lot of questions, not answers.''* [Only SSH practitioners laughed]. The discussion on the participant's prompts against our questions (1,2,3,4) lead to further research questions about how to investigate SSH integration in other ways which were not considered during the sandpits. For instance, when deciding policy intervention to foster interdisciplinary research, where should EU funds go? To already-recognised interdisciplinary researchers, or to researchers showing up precisely to catch those funds and thus self-labelling as interdisciplinary ones? Moreover, how to underpin the endurance of this interdisciplinary collaboration? Another question is related to the scope of funding interdisciplinary research: should it be addressed to funding new products (new technologies, new protocols) or to empower an authentic epistemic interdisciplinary approach to frame new energyrelated issues? Further thorny questions relate to the measurement of the effective integration of SSH: is it enough to state that two/thirds of the participant organizations define themselves as SSH, or would it be better to dedicate a funding slot exclusively to SSH individuals, within or outside the SSH (self-defined) partners? If the EU calls' goal is to deliver concrete results for societal challenges, short-term integration may fit the scope. However, building capacities for long-term interdisciplinary communities or centres appears crucial for measuring and calling for permanent societal outcomes.

4. Conclusions

This paper describes the implementation and the outcomes of four sandpits carried out during the EU project SHAPE ENERGY, aimed at including space for discussion of different questions that challenge the status quo on energy-SSH integration. The topics of the sandpits were: `Energy efficiency and using less'; `Competitive, secure, low carbon energy supply'; `Energy system optimisation and smart technologies'; and `Transport sector decarbonisation'. In total, 75 people attended the sandpits, representing institutions from 17 different countries. Through this sandpit format, we hoped to bring different disciplines and stakeholders together to: produce novel insights; learn more about the possibilities of SSH in what has become a rather (STEM-dominated) technical landscape of EU-funded projects; give participants the opportunity to forge collaborative connections that could last well into the future. Our main findings emphasise how SSH is still predominantly regarded as a means to orient the market and encourage individuals to accept a top-down policy, technology or process, and this is further illustrated through the ways that the Horizon 2020 energy and transport calls are fundamentally framed and positioned. While the rhetoric of SSH is usually very welcomed, very few projects appeared to integrate or adopt it in practice, cherry-picking just a few SSH to build capacity for interdisciplinary collaboration. The isomorphisms of most of the proposals testify that solutions are often biased by shaping themselves to adapt to already winning proposals. This makes it difficult to make progress in integrating energy-related SSH for effective use of interdisciplinarity or for providing important perspectives on addressing societal challenges. Another weakness is that, through the sandpit approach, discourses remained mainly qualitative, with few quantitative/ precise policy recommendation/solutions to address the barriers that emerged during the discussions. Storytelling has been useful for communication purposes and in-person social networking, but not for building a concrete proposal or new knowledge co-creation, maybe also because the second phase (after the first barrier-breaking phase) was not too strongly top-driven and there was not too much time for further collective moments. In this perspective, it seems to us that future Horizon calls could enhance the role of SSH as agents to figure out the needs, perceptions and expectations of individuals when dealing with energy transition. Research findings from the energy-related Social Sciences and Humanities (energy-SSH) are fundamental to understanding and meeting energy policy challenges. Neglecting SSH insights – for example into the social, political, historical and psychological dimensions of energy transitions – risks failing to meet Europe's ambitious visions for its energy future. Leveraging on our study, clear actions for European funders, policy-workers and researchers to support a more impactful role for energy-SSH in defining the energy agenda over 2020–2030 could see SSH featured more explicitly in Horizon Europe's energy research and innovation funding opportunities, compared to Horizon 2020. Core SSH issues need to be more deeply integrated into technical energy projects which seek to address societal challenges. This could also inform political and technological solutions that may answer to these issues, too, and not only to self-ruled processes of innovation and technological reproduction and justification. The Vilnius declaration states that ``*[...] the effective integration of SSH requires that they are valued, researched and taught in their own right as well as in partnership with other disciplinary approaches*'' as in the EURAB publications ([27], p.1). Also, Horizon Europe energy calls should explicitly consider which SSH disciplines they focus attention on, and report on how this is being addressed. In turn, the European Commission should more actively recruit energy-SSH expertise for Horizon Europe's proposal evaluator databases and panels, and set also qualitative measures to meaningfully monitor the successful integration of SSH in energy projects. While SSH should feature in interdisciplinary energy projects' concepts (i.e. setting the project direction), not only as a tool to generate impact (i.e. an add-on at the end), research on how to make interdisciplinarity happen is vital to our collective interests both as scientists and as citizens. It will require more and more collaboration across various boundaries of academia, policymaking, industry and civil society. If interdisciplinarity must have a long-term policy, and the role of the European Commission in this regard, as any funding agency, is crucial. The more clearly we can articulate the bridges between those boundaries, the easier those unique collaborations will be. Our intention is that the blue-sky sandpit experiment, along with the storytelling, the impro-theatre exercises, the use of hands and heart in collaborative multi-stakeholder moments of free co-creation, the dialogue walk across arts and food experiences, the real-time graphic illustrations and all the other tools we explored and described in this paper, can help to trigger more research on how to make inter and trans disciplinary work happen. The path toward a more collaborative attitude among scientists, both when designing EU calls and in designing projects proposals related to energy topics, is totally in line with the logic of the 17 Sustainable Development Goals (SDGs) agenda, calling for further interdisciplinary and society-relevant research and innovation, through enhanced multi-stakeholder cooperation and interdisciplinary communication on complex topics.

Declaration of Competing Interest

None.

Acknowledgements

We acknowledge the significant influence in structuring this article and drawing sound conclusions after the input by Chris Foulds and Rosie Robison, minds and hands of the H2020 funded project SHAPE ENERGY ``Social Sciences and Humanities for Advancing Policy in European Energy''. We also would like to thanks the huge work of the reviewers and the editors that brought this article at the level of the journal in which you are reading it. The SHAPE ENERGY project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 731264. We want to thank all those who contributed to the sandpits and their organisation, including the keynote speakers: Andrea Bonaccorsi and Gerd Schonwalder. The panellists: Piero Boccardo, Daniela Ciaffi, Pierluigi Leone, Enrico Macii, Marco Masoero and Dario Padovan. The improvisational theatre actors of Quinta Tinta: Roberto Garelli and Lara Mottola. The real-time illustrators of RUBRA studio: Marco Grazioso, Gian Maria Mazzei, and their assistant Beatrice Meloni. The other members of the `Politecnico di Torino SHAPE ENERGY team' whom all gave essential contributions to the planning and the implementation of the sandpits: Francesca Abastante, Antonella Castellani, Francesca Coletta, Maria Valentina Di Nicoli, Costanzo Mercugliano, Luisa Montobbio, Cinzia Pagano, Jacopo Toniolo and Sara Torabi. Finally, we would like to thank the restlessness attitude toward the perfection of Lenke Balint, project manager of SHAPE ENERGY, that made possible all our activities, and of course all sandpits participants for their enthusiastic participation. We hope they enjoyed the sandpits and found them fruitful as much as we did.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.erss.2019.101342.

Appendix Table A1.

Table A1 Names and titles of the 36 projects attending the sandpits.

Ambition Advanced biofuel production with energy system integration
BestRES Best practices and implementation of innovative business models for Renewable Energy aggregatorS
Bio-HyPP Biogas-fired Combined Hybrid Heat and Power Plant
BIOROBURplus Advanced direct biogas fuel processor for robust and costeffective decentralised hydrogen production
BRISK2 Biofuels Research Infrastructure for Sharing Knowledge
BRISKEE Behavioural Response to Investment Risks in Energy Efficiency
CEMCAP CO2 capture from cement production
CONSEED CONSumer Energy Efficiency Decision Making
E2District Energy Efficient Optimised District Heating and Cooling
EMPOWERING Empowering Local Public Authorities To Build Integrated Sustainable Energy Strategies

enCOMPASS Collaborative Recommendations and Adaptive Control for Personalised Energy Saving
ENERGISE European Network for Research, Good Practice and Innovation for Sustainable Energy
ENLARGE ENergies for Local Administrations: Renovate Governance in Europe
EnPC-INTRANS Capacity Building on Energy Performance Contracting in European Markets in Transition
ENTRUST Energy System Transition Through Stakeholder Activation, Education and Skills Development
ESA 2.0 Pushing forward irradiation monitoring efficiency in the PV industry
FLEXMETER Flexible smart metering for multiple energy vectors with active prosumers
GEMex Cooperation in Geothermal energy research Europe-Mexico for development of Enhanced Geothermal Systems and Superhot Geothermal Systems
IRON Innovative turbopROp configuration
ISABEL Triggering Sustainable Biogas Energy Communities through Social Innovation
LIMPET Low Maintenance, High Security, Pipeline Leak Detection Through Continuous Monitoring And Real Time Alerts
MAGIC-NEXUS Moving Towards Adaptive Governance in Complexity: Informing Nexus Security
MOBILITY4EU Action Plan for the future of Mobility in Europe
MOBISTYLE MOtivating end-users Behavioral change by combined ICT based tools and modular Information services on energy use, indoor environment, health and lifestyle
NATCONSUMERS NATural Language Energy for Promoting CONSUMER Sustainable Behaviour
PEMs4Nano Portable Nano-Particle Emission Measurement System
PVSITES Building-integrated photovoltaic technologies and systems for large-scale market deployment
RenGen Onsite, On-demand, Self-standing Cost Competitive Zero-Carbon Power Generation
ShaleXenvironmenT Maximizing the EU shale gas potential by minimizing its environmental footprint
SHAR-Q Storage capacity sharing over virtual neighbourhoods of energy ecosystems
START2ACT Engaging European Start-ups and Young SMEs for Action for Sustainable Energy
STOREandGO Innovative large-scale energy STOragE technologies AND Power-to-Gas concepts after Optimisation
SWInG Development of thin film Solar cells based on WIde band Gap kesterite absorbers
THOMSON Mild Hybrid cOst effective solutions for a fast Market penetration
UPGRADE High efficient Particulate free Gasoline Engines
ZERO-PLUS Achieving near Zero and Positive Energy Settlements in Europe using Advanced Energy Technology

References

[1]Beede, D.N., Julian, T.A., Langdon, D., McKittrick, G., Khan, B., Doms, M.E., 2011. Women in STEM: a gender gap to innovation.
[2] T. Bloemers, S. Daniels, G. Fairclough, B. Pedroli, R. Stiles, Landscape in a Changing World; Bridging Divides, Integrating Disciplines, Serving Society, European Science Foundation ESF-COST, 2010.
[3] A. Bonaccorsi, The Evaluation of Research in Social Sciences and Humanities, Springer, 2018, pp. 1–29.
[4] R. Burrows, Living with the H-index? Metric assemblages in the contemporary academy, Sociol. Rev. 60 (2012) 355–372.
[5] N. Cartwright, S. Efstathiou, Hunting causes and using them: is there no bridge from here to there? Int. Stud. Philos. Sci. 25 (2011) 223–241.
[6] B. Cronin, C.R. Sugimoto, Beyond Bibliometrics: Harnessing Multidimensional Indicators of Scholarly Impact, MIT Press, 2014.
[7]EURAB, 2004. Recommendations on the European Research Area (ERA) and the Social Sciences and Humanities (SSH).
[8] D. Foray, D.C. Mowery, R.R. Nelson, Public R&D and social challenges: what lessons from mission R&D programs? Res. Policy 41 (2012) 1697–1702.
[9]Foulds, C., Robison, R.A. V, Balint, L., Sonetti, G., 2017. Headline reflections- SHAPE ENERGY Call for Evidence.
[10] Fox, E., Foulds, C., Robison, R., 2017. Energy & the active consumer-a social sciences and humanities cross-cutting theme report.

[11] R. Frodeman, J.T. Klein, R.C.D.S. Pacheco, The Oxford Handbook of Interdisciplinarity, Oxford University Press, 2017.
[12] R. Galvin, Making the `rebound effect' more useful for performance evaluation of thermal retrofits of existing homes: defining the `energy savings deficit' and the `energy performance gap.', Energy Build. 69 (2014) 515–524.
[13] J. Gottschall, The Storytelling Animal: How Stories Make us Human, Harcourt, Houghton Mifflin, 2012.
[14] P. Holm, M.E. Goodsite, S. Cloetingh, M. Agnoletti, B. Moldan, D.J. Lang, R. Leemans, J.O. Moeller, M.P. Buendia, W. Pohl, Collaboration between the natural, social and human sciences in global change research, Environ. Sci. Policy 28 (2013) 25–35.
[15] Kastrinos, N., 2001. Contribution of socio-economic research to the benchmarking of RTD policies in Europe.
[16] N. Kastrinos, The European Community Framework Programme as Technology Policy: Towards an Assessment, University of Manchester, 1998.
[17] P. Keraudren, The contribution of social sciences and the humanities to research addressing societal challenges. Towards a policy for interdisciplinarity at European level? in: A. Tressaud (Ed.), Progress in Science, Progress in Society, Springer international publishing AG, 2018, pp. 43–57.
[18] B. Konig, K. Diehl, K. Tscherning, K. Helming, A framework for structuring interdisciplinary research management, Res. Policy 42 (2013) 261–272, https://doi.org/ 10.1016/j.respol.2012.05.006.
[19] J. Lambert, Digital Storytelling: Capturing Lives, Creating Community, Routledge, 2013.
[20] C. Lyall, L.R. Meagher, A Masterclass in interdisciplinarity: research into practice in training the next generation of interdisciplinary researchers, Futures 44 (2012) 608–617, https://doi.org/10.1016/j.futures.2012.03.011.
[21] M. Mazzucato, From market fixing to market-creating: a new framework for innovation policy, Ind. Innov. 23 (2016) 140–156.
[22] M. Mazzucato, C. Penna, Mission-Oriented Finance for Innovation: New Ideas for Investment-Led Growth, Policy Network and Rowman & Littlefield International, 2015.
[23] M. Moezzi, K.B. Janda, S. Rotmann, Using stories, narratives, and storytelling in energy and climate change research, Energy Res. Soc. Sci. 31 (2017) 1–10, https:// doi.org/10.1016/j.erss.2017.06.034.
[24] K. Moore, Exposing hidden relations: storytelling, pedagogy, and the study of policy, J. Tech. Writ. Commun. 43 (2013) 63–78.
[25] Mourik, R., Robison, R., Breukers, S., 2018. Storytelling. Cambridge.
[26] K.F. Mulder, J. Segalas, D. Ferrer-Balas, How to educate engineers for/in sustainable development: ten years of discussion, remainin challenges, Int. J. Sustainability Higher Educ. 13 (3) (2012) 211–218.
[27] OSCE, 2013. Vilnius declaration—horizons for social sciences and humanities.
[28] G. Parsell, Educational principles underpinning successful shared learning, Med. Teach. 20 (1998) 522–529.
[29] M. Pellegrino, M. Musy, Seven questions around interdisciplinarity in energy research, Energy Res. Soc. Sci. 32 (2017) 1–12, https://doi.org/10.1016/j.erss.2017. 07.007.
[30] D. Rhoten, S. Pfirman, Women in interdisciplinary science: exploring preferences and consequences, Res. Policy 36 (2007) 56–75.
[31] I. Ropke, T.H. Christensen, J.O. Jensen, Information and communication technologies–A new round of household electrification, Energy Policy 38 (2010) 1764–1773.
[32] L. Schiebinger, M. Schraudner, Interdisciplinary approaches to achieving gendered innovations in science, medicine, and engineering1, Interdiscip. Sci. Rev. 36 (2011) 154–167.
[33] G. Schuitema, N. D. Sintov, Should we quit our jobs? Challenges, barriers and recommendations for interdisciplinary energy research, Energy Policy 101 (2017) 246–250, https://doi.org/10.1016/j.enpol.2016.11.043.
[34] N. Schulenkorf, D. Edwards, Maximizing positive social impacts: strategies for sustaining and leveraging the benefits of intercommunity sport events in divided societies, J. Sport Manag. 26 (2012) 379–390.
[35] E. Shove, G. Walker, CAUTION! Transitions ahead: politics, practice, and sustainable transition management, Environ. Plan. A 39 (2007) 763–770.
[36] G. Sonetti, M. Brown, E. Naboni, About the triggering of UN sustainable development goals and regenerative sustainability in higher education, Sustainability 11 (2019) 254.

[37] B.K. Sovacool, What are we doing here? Analyzing fifteen years of energy scholarship and proposing a social science research agenda, Energy Res. Soc. Sci. 1 (2014) 1–29, https://doi.org/10.1016/j.erss.2014.02.003.
[38] B.K. Sovacool, S.E. Ryan, P.C. Stern, K. Janda, G. Rochlin, D. Spreng, M.J. Pasqualetti, H. Wilhite, L. Lutzenhiser, Integrating social science in energy research, Energy Res. Soc. Sci. 6 (2015) 95–99, https://doi.org/10.1016/j.erss. 2014.12.005.
[39] J.J.H. Steenbakkers, Y. Lu, M. Brinkema, P. Gultekin, L. Valentine, B. Borja de Mozota, J. Nelson, The creation of professional empathy during multi-stakeholder collaboration, The Value of Design Research, Proceedings of the 11th International Conference of the European Academy of Design, 2015, pp. 22–24.
[40] P. Stock, R.J.F. Burton, Defining terms for integrated (multi-inter-trans-disciplinary) sustainability research, Sustainability 3 (2011) 1090–1113.
[41] Y. Strengers, Smart Energy Technologies in Everyday Life: Smart Utopia? Springer, 2013.
[42] M. Sunikka-blank, R. Galvin, Introducing the prebound effect: the gap between performance and actual energy consumption, Build. Res. Inf. (2012) 260–273, https://doi.org/10.1080/09613218.2012.690952.
[43] E. Tavella, I. Lami, Negotiating perspectives and values through soft OR in the context of urban renewal, J. Oper. Res. Soc. (2018) 1–26.
[44] F.J. Van Rijnsoever, L.K. Hessels, Factors associated with disciplinary and interdisciplinary research collaboration, Res. Policy 40 (2011) 463–472.
[45] J. Viitanen, R. Kingston, Smart cities and green growth: outsourcing democratic and environmental resilience to the global technology sector, Environ. Plan. A 46 (2014) 803–819.
[46] W.M. Williams, S.J. Ceci, National hiring experiments reveal 2: 1 faculty preference for women on STEM tenure track, Proc. Natl. Acad. Sci. (2015) 201418878.
[47] R. Wodak, P. Chilton, A New Agenda in (Critical) Discourse Analysis: Theory, Methodology and Interdisciplinarity, John Benjamins Publishing, 2005.
[48] A. Sharma, K. Kearins, Interorganizational collaboration for regional sustainability: What happens when organizational representatives come together? The Journal of Applied Behavioral Science 47 (2) (2011) 168–203.
[49] E. O’Sullivan, Maureen Berner, J. DeVance Taliaferro, R.R. Gary, *Research Methods for Public Administrators*, Routledge, 2016.
[50] A. Strauss, M.C. Juliet, *Grounded Theory in Practice*, Sage, 1997.
[51] Heidenreich, Sara, William Throndsen, Ramazan Sari, Giulia Sonetti, Marianne Ryghaug, Thomas Kern-Gillard, Osman Arrobbio, Ruth Mourik, and Angel Nikolaev. "Competitive, secure, low-carbon energy supply–a social sciences and humanities annotated bibliography." (2017).
[52] Koenig, T., 2019. SSH-Impact Pathways and SSH-Integration in EU Research Framework Programmes.
[53] D.B. Pedersen, Integrating social sciences and humanities in interdisciplinary research, Palgrave Commun 2 (2016) 16036, https://doi.org/10.1057/palcomms. 2016.36.
[54] K. Buchmann, R. Robison, C. Foulds, Transport Sector Decarbonisation – a Social Sciences and Humanities Annotated Bibliography, SHAPE ENERGY, Cambridge, 2017.
[55] V.A. Shaffer, E.S. Focella, A. Hathaway, L.D. Scherer, B.J. Zikmund-Fisher, On the Usefulness of Narratives: An Interdisciplinary Review and Theoretical Model, Ann. Behav. Med. 52 (2018) 429–442, https://doi.org/10.1093/abm/kax008.
[56] H. Chappells †, E. Shove, Debating the future of comfort: environmental sustainability, energy consumption and the indoor environment, Build. Res. Inf. 33 (2005) 32–40, https://doi.org/10.1080/0961321042000322762.
[57] H. Della Bosca, J. Gillespie, The coal story: Generational coal mining communities and strategies of energy transition in Australia, Energy Policy 120 (2018) 734–740 https://doi.org/10.1016/j.enpol.2018.04.032.
[58] J.T. Klein, Reprint of “Discourses of transdisciplinarity: Looking back to the future, Futures 65 (2015) 10–16, https://doi.org/10.1016/j.futures.2015.01.003.
[59] F.O. Odemerho, Building climate change resilience through bottom-up adaptation to flood risk in Warri, Nigeria, Environ. Urban. 27 (2015) 139–160, https://doi.org/ 10.1177/0956247814558194.
[60] D. Stokols, R.P. Lejano, J. Hipp, Enhancing the Resilience of Human–Environment Systems: a Social Ecological Perspective, Ecol. Soc. 18 (2013), https://doi.org/10.5751/es-05301-180107.

[61] R.W. Kates, W.R. Travis, T.J. Wilbanks, Transformational adaptation when incremental adaptations to climate change are insufficient, Proc. Natl. Acad. Sci. 109 (2012) 7156–7161, https://doi.org/10.1073/pnas.1115521109.
[62] F. Moulaert, D. MacCallum, A. Mehmood, A. Hamdouch, The International Handbook on Social Innovation, Collective Action, Social Learning and Transdisciplinary Research (2013).
[63] D. Spreng, Transdisciplinary energy research - Reflecting the context, Energy Res. Soc. Sci. 1 (2014) 65–73, https://doi.org/10.1016/j.erss.2014.02.005.
[64] S. Thomas, M. Richter, W. Lestari, S. Prabawaningtyas, Y. Anggoro, I. Kuntoadji, Transdisciplinary research methods in community energy development and governance in Indonesia: Insights for sustainability science, Energy Res. Soc. Sci. (2018).
[65] C. Wilson, T. Hargreaves, R. Hauxwell-Baldwin, Smart homes and their users: a systematic analysis and key challenges. Pers, Ubiquitous Comput 19 (2015) 463–476, https://doi.org/10.1007/s00779-014-0813-0.