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Exploring public engagement with geothermal energy in southern Italy: A case study

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HIGHLIGHTS

- Original research based contribution on public views on geothermal energy.
- Results show that geothermal energy might have conflict potential.
- Deep seated distrust in institutions, companies and decision makers.
- Reflections upon public engagement activities in energy policy making.

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ABSTRACT

This paper presents the results of an assessment of public views on eventual geothermal energy development in Sicily. The research was carried out under a much wider research project, VIGOR, with the aim to explore the feasibility of geothermal energy utilization in southern Italy. This study has two primary objectives: (1) to explore the views and opinions of local communities regarding the potential of geothermal energy applications; (2) to contribute to the growing literature on public engagement with energy issues. In order to explore public views towards geothermal technologies, we conducted a case study using both qualitative and quantitative methods. Although Italy has enormous geological potential for geothermal energy production, levels of knowledge of this energy source amongst the public are low. The results indicate that the issue is shrouded in uncertainty and that the Sicilian public expresses a diffused lack of trust in decision-making processes. Taken together, these factors are likely to strongly impact eventual further developments in this sector. The results clearly show the need for further societal dialogue supported by a sound communication action strategy as the first stage in a public participation.

1. Introduction

1.1. A short history of geothermal energy in Italy

Italy was a pioneering country in exploiting the potential of geothermal resources for energy power production. Already in 1904, when Piero Ginori Conti successfully experimented with the generation of electricity from geothermal steam, the first geothermal power plant was built in Larderello in Tuscany (Luzzini, 2012). Italy is presently ranked in the top five countries worldwide for geothermal power production and, according to the European Geothermal Energy Council, it is expected to produce by 2020 an electricity installed capacity of 1965 MW and 15.600 GWh, which is the 4.2% of the national energy demand (Zervos et al., 2011). Data collected in 2010 show that the geothermal production in Italy is now only 1.8% of the total national electricity production, but it is about 25% for Tuscany, where the two major geothermal areas of the country are located: Larderello-Travale/Radicondoli and Mount Amiata (Bertani, 2012). There are few studies on public views on geothermal energy and the case study reported upon in this paper was carried out within a much

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wider interdisciplinary project, VIGOR, funded by the Italian government.[1] VIGOR is dedicated to assessing the feasibility of developing geothermal energy in four regions of southern Italy (Albanese et al., 2014) and to the diffusion of knowledge of the numerous geothermal energy technologies (Botteghi et al., 2012; Abate et al., 2014).

1.2. Social acceptance of renewables and RRI

Although the importance of the role of social research in energy studies has long been recognized, social sciences currently play a surprisingly marginal role in energy research (Pidgeon et al., 2014, Stirling, 2014). Engineers, scientists, economists and policy makers focus on technical details and often ignore the importance of taking into account the lifestyles of the communities and their social norms (Sovacool, 2014).

The term '*social acceptance*' is often used in the energy policy literature, but clear definitions are hard to find. In the case of renewables, Wüstenhagen et al. (2007) defined social acceptance as a combination of three different dimensions: (i) socio-political acceptance that is the acceptance considered at a broadest, general level and relates with technology itself, public perception, key stakeholders and policy makers; (ii) community acceptance that refers to specific decisions about sites and relates to procedural justice, distributional justice and trust; and (iii) market acceptance that has mainly to do with consumers, investors and intra-firm relations.

Published studies on social acceptance of geothermal energy are very few and most of them are quite recent. Polyzou and Stamataki (2010) used a survey to study social acceptance of geothermal energy on the Greek islands of Milos and Nisiros, where public information and the active involvement of citizens were considered essential elements of project design and management. Dowd et al. (2011) developed an engagement workshop aimed at providing the general public in Australia with the opportunity to interact with scientists experts in geothermal energy: the results show a general support for the technology, low levels of knowledge of the technology, and some concern about induced seismicity and water usage associated with geothermal systems. Carr-Cornish and Romanach (2012) explored public views on geothermal energy in Australia using a mix of media analyses, online and face-to-face focus group and a questionnaire distributed during focus group. Geothermal energy was perceived positively in the battle against climate change and for promoting low carbon societies, while the perceived risks are related to economic feasibility, technical uncertainties, potential seismic activity and water pollution.

In general, technologies for the harnessing of renewable energy are positively viewed by the European public, although interestingly enough, levels of acceptance in Italy are somewhat lower than the EU average (Gaskell et al., 2010, 2011). In recent years, European Union's mission to encourage scientific innovation and develop a knowledge-based society capable of creating new jobs and prosperity, while preserving the environment and meeting societal needs, has merged into a new approach termed Responsible Research and Innovation (Owen et al., 2012; von Schomberg, 2013).

One of the pillars of the Responsible Research and Innovation (RRI) approach is to embed considerations of societal needs and ethics in the innovation process and that requires the involvement of social sciences. This approach strongly encourages "upstream" engagement (see Jasanoff, 2007) of stakeholders (politicians, manager, citizens, associations, etc.) already in the early stages of the innovation process. This allows all stakeholders to (i) be aware of the consequences of their actions and of the range of options open to them, (ii) evaluate outcomes and options of every possibility in terms of ethical values, including equality, autonomy, sustainability, democracy and efficiency, and (iii) use these considerations as functional requirements to design and develop new research, products, and services (Van den Hoven et al., 2013).

RRI might be heralded as a new approach, but it evidently shares some features with strong ecological modernization (EM) theories (Breukers and Wolsink, 2007b; Gibbs, 2000), intended as valuable conceptual framework "for gaining an understanding of the ways in which environmental considerations and interests trigger changes in (global) institutions and social practices that are heavily infected by globalization" (Mol, 2002, p. 110) and conditioned by the progressive metamorphosis of government into governance (Jordan et al., 2003). According to this approach, the traditional patterns related to environmental policy are changing and new agents, like the civil society, are considered key actors in shaping environmental politics.

1.3. Society and carbon lock-in energy system

It is often claimed that industrial countries have become "locked into" fossil fuel based systems through path dependent processes culminating in the techno-institutional complex (TIC) brought about by technological, organizational, social and institutional co-evolution (Unruh, 2002). From this perspective, as institutions are by definition rather resistant to change, social change often precedes and outpaces institutional change.

The complexity of innovation process is further emphasized by Jacobsson and Johnson (2000, p. 629) who argue that "the determinants of technology choice are not only to be found within individual firms, but also reside in an "innovation system" which both aids and constrains the individual actors making a choice of technology within it". The system is composed by three main elements: the actors and their competence, the networks and the institutions. These components can reinforce one other and act as inertial forces that prevent innovation in favor of existing technologies.

Lehmann et al. (2012, p. 325) define this "path dependence" as "the result of contingence and increasing returns to scales favoring a certain technology or country without being intrinsically superior to alternatives". Authors describe in nuanced details the carbon lock-in barriers preventing innovation that, with the exception of "generation barriers", have long been neglected. The diversification of the barriers described and the set of solutions proposed, clearly show how energy innovation requires simultaneously and coordinated efforts by different social actors (i.e. policy makers, investors, civil society).

Diverse options engaging society as a whole are proposed in the literature in order to overcome carbon-lock in energy systems and activate renewable energy innovation mechanisms. Jacobsson and Johnson (2000) identify "prime movers" as potential key actors able to trigger innovation. Unruh (2002) hypothesizes that a discontinuity to existing energy system could come from a niche approach or special interest groups. Pilot projects are also encouraged as previous steps towards renewables development in areas where largely unknown technologies are to be tested (Lehmann et al., 2012). External events that impact society, shape opinions and press institutional interventions (i.e., climate change

[1] This research was conducted within the VIGOR project, a three-year program dedicated to a comprehensive assessment of geothermal energy potentials and applications in four regions of Italy (Apulia [Puglia], Calabria, Campania, Sicily [Sicilia]). VIGOR aims to study a wide array of geothermal applications, from low to high enthalpy, depending on the natural resources and the economic and social aspects of the reference territories. Consistent with the RRI approach, the VIGOR Project is investigating the geothermal potential of southern Italy by adopting a comprehensive approach that includes social studies such as our case study (Albanese et al., 2014).

related events) can also play a key role in activating innovation (Unruh, 2002) and a recent example is provided by Japan, where the government is responding to the nuclear disaster promoting renewable energies by a new feed-in tariff (Huenteler et al., 2012). The repercussions of the Fukushima disaster has impacted energy policies in many countries, including Germany and Italy.

Many of the differences between renewables and fossil fuel energy systems can be attributed to the distributional nature of the first and the highly centralized nature of the latter. Decentralized socio-technical networks are needed in order to develop high levels of interaction and integration between communities and social actors who are increasingly becoming autonomous in energy production (Wolsink, 2012b). As influentially argued by Ostrom (2010, p. 552): "polycentric systems tend to enhance innovation, learning, adaptation, trustworthiness, levels of cooperation of participants, and achievement of more effective, equitable, and sustainable outcomes at multiple scales". This is particularly the case for direct uses of geothermal energy due to its intrinsic distributed nature.

1.4. Nimby, place attachment and trust

Traditionally, local opposition to technological implementation has been described as the Not-In-My-Back-Yard syndrome. However, many authors consider this inappropriate and misleading concept (e.g. Devine-Wright, 2011b, Wolsink, 2012a). Breukers and Wolsink (2007a) put forward three main reasons to support collaborative decision making processes in energy policy, similar to those embedded in the RRI approach. Firstly, the participation of relevant stakeholders in a project design-phase brings knowledge and experiences and contributes to improve the quality of the project itself. Secondly, empirical research on wind energy shows that negative attitudes towards single projects can be reinforced by the perception of unfair decision-making process. On the contrary, several studies on facilities siting show that collaborative decision making is "more conducive to the eventual realization of the facility compared to top-down decision-making" (Breukers and Wolsink, 2007a, p. 2738). Finally, collaborative decision-making enhances the democratic legitimacy of both innovation processes and the outcomes.

In order to overcome the simplicities of the Nimby explanation of social responses to renewable energies projects, some authors suggest the concept of place attachment and "specifically disruption to place attachment, in explanatory accounts of local acceptance or opposition" (Devine-Wright and Howes, 2010, p. 277). Recent studies on tidal energy show that place attachment and acceptance of a single project can also be positively related. As we find in Devine-Wright (2011a, p. 341) "change to places is not inevitably disruptive, but may enhance place attachments in situations of good 'fit' between symbolic meanings associated with both place and project". The lessons learned from studies of public views on harnessing tidal and wind energy might provide important insights for the less explored field of geothermal energy. In summary, the relationship between place attachment and community responses to developments depends on social context and is moderated by trust in key stakeholders involved in the project itself (Devine-Wright and Howes, 2010).

Trust is a key concept in the literature on science, technology and society. The difference between the concept of trust and the concept of confidence is best developed (Luhmann, 2000): while confidence emerges in situations characterized by danger or contingency, trust emerges in situations of risks, where risk exists only as a component of decision and action, implying therefore mutual responsibility and the need of cooperation. In other words, trust acts as a substitute for knowledge in complex societies characterized by risk (Beck, 1992). Trust has been further defined and operationalized as a "dual" concept, composed by confidence, the competence and the technical ability to operate, and social trust or common values (Siegrist et al., 2003). According to Gambetta (2000), mutual trust is a prerequisite for cooperation and should be accompanied by long-term arrangements, the absence of potentially aggressive devices, the lack of ambiguity in what people cooperate for and a step by step increase in the risk involved in cooperation. Trust requires therefore strong and continuous efforts in communication.

The extensive literature on trust and risk communication indicates that trust contributes to shaping perceptions, opinions and public attitudes (Renn and Levine, 1991; Poortinga and Pidgeon, 2003). Several researchers associate trust with acceptability and risk perception that in turn depends strongly on communication. Trust in communication processes is an essential component of public engagement processes, especially when different levels of knowledge exist between different parties. "Trust in communication refers to the generalized expectancy that a message received is true and reliable and that the communicator demonstrates competence and honesty by conveying accurate, objective and complete information" (Renn and Levine, 1991). Within the general trend of growing distrust in public institution in modern societies (Pellizzoni, 2003, 2010), building trust needs strong efforts at institutional levels. The notion of public upstream engagement, embedded in a Responsible Research and Innovation approach, was designed and intended to restore or reinforce trust between publics, stakeholders and institutions and some very interesting critical contributions have been made to the literature on public engagement recently (e.g. Stilgoe et al., 2014; Stirling, 2014).

2. Methods

2.1. Overview of literature on methods of public engagement

Research on the relationship between society and scientific and technological progress has gone through stages that each one sets the agenda in terms of the preferred methodological approach of each stage. The research agenda has gone from science literacy, with emphasis on public education, through public understanding with the emphasis on attitude research to the present science in society approach where public participation and deliberative exercises are considered the privileged approach (Bauer et al. 2007; Owen et al., 2012, Stilgoe et al., 2014). At times it appears that the research techniques are considered to be problematic, rather than the object of research, such as the critique of survey research as being overly constraining and only capturing the views of the public as framed by those who design the instruments (Jasanoff, 2005).

Public engagement and participation have been very much on the agenda from the beginning of this century, although that depends on individual countries. Countries such as Austria, Denmark Germany, the Netherlands, and the UK all have public mechanisms embedded in their institutionalised approaches to technology assessment while for example Italy does not have such procedures in place (Mejlgaard and Bloch, 2012). Although the public engagement agenda is still high on the agenda of the European Commission (von Schomberg, 2013) further efforts are needed to clarify what the mechanisms of public engagement are actually meant to achieve (Hagendijk and Irwin, 2006). A clear and influential overview of public engagement mechanism was provided by Rowe and Frewer (2005). They differentiate between three types of initiatives based on the flow of information between participants and sponsors. Firstly, public communication where information is given to the public by the sponsors of the initiative. Secondly, public consultation, where information is gathered from

the public and conveyed to the sponsors, although no real dialogue takes place between the parties. Thirdly public participation, where information is exchanged between the sponsor and the public. The literature on public engagement is rapidly growing, but there is as yet no consensus on which approach is the most appropriate, or effective for that matter, and researchers have to make informed choices about the approach applied to their research into how a given public and stakeholders engage with developments. In our case we opted for a combination of quantitative and qualitative approaches and techniques of analysis for an exercise that should be placed somewhere between public consultation and public participation in the above classification of public engagement initiatives.

2.2. Data

2.2.1. Sources of data

Termini Imerese is one of the 8 sites chosen as case studies by the VIGOR Project to assess the geothermal potential of four Regions of southern Italy (Manzella, 2013). The occurrence of two main hot springs, "Bagni Vecchi" and "Bagni Nuovi", with flow rates between 5 and 15 l/s and temperatures around 42 °C, prove the occurrence of hydrothermal circulation in the area. Based on the geothermal potential defined by geological, morphological, and hydrogeological analyses, as well as geochemical sampling and geophysical investigation, some innovative solutions have been suggested, including the traditional touristic and therapeutic sector (thermal baths), district heating, and desalination of seawater.

The participants in the research in Termini Imerese were arguably particularly sensitive to social, political and economic aspects of innovation and energy policies when the fieldwork was carried out (October 2012). The social and economic fabric of the area had been hard hit by rapid de-industrialization and high levels of unemployment and the present economic crisis coupled with the impending regional elections, following a political scandal, might have accentuated the poignancy of the situation.

For almost half a century, the local economy had been somewhat dominated by the Fiat automobile production plant of Termini Imerese, founded in 1970. The crisis of the industry (December 2011) caused a 0.46% reduction of the Sicilian GDP, the loss of 3500 jobs, the closure due to bankruptcy of 54 local businesses, and a decrease in the local population.

2.2.2. Data description

To explore public views and attitudes towards geothermal energy technologies at Termini Imerese (Sicily), we opted for a mix of methods (1) quantitative (survey) and (2) qualitative (focus groups). The two parts of this case study were prepared simultaneously with the aim of using the latter part to further explore the results from the former. The results of the survey had just been made available when the focus groups were conducted. Surveys give insightful indications on the distribution of sets of beliefs across social groups and segments, while focus groups allow participants to further elaborate upon their points of view on the subject under discussion, resulting in a more fine-grained or nuanced picture.

(1) A sample of 400 citizens out of the population living in the Palermo Province (where Termini Imerese is sited) was recruited by a survey agency and commissioned by the CNR. The sample was calibrated by gender, age and job condition.[2] The questionnaire was designed by members of the VIGOR consortium. All questions of the survey (except one, see below) were ranked on a six-point scale ranging from 1 (very low level of agreement/acceptability) to 5 (very high level of agreement/acceptability), and including 0 for uncertainty.[3] The survey was administered by phone using the CATI (computer-assisted telephone interviewing) method.

(2) Qualitative interviewing (focus groups) refers to semi-structured interviews with a group of 8 respondents each, with the aim of eliciting the views and opinions of participants with different backgrounds from those of the persons initiating the interviews (Bauer and Aarts, 2000; Krueger and Casey, 2009; Morgan, 1997). A common discussion guide was defined for all groups.[4] As the aim of focus group interviewing is to encourage a focused discussion amongst the participants, the groups were moderated by a natural scientist, the facilitator, and a social psychologist who acted as an observer and helped to keep the discussion on track and probe participants further on their views and positions when needed. Focus groups were conducted with four different groups of citizens and stakeholders from the selected area: a total of 32 people were recruited by a survey agency. The four focus groups were (a) a group of University students, as they are young, have higher levels of instruction than average and tend to have developed greater information seeking skills (b) members of the general public of Termini Imerese (Citizens Focus Group), (c) local policy makers and stakeholders of the energy sector (Stakeholders Focus Group), and (d) ex-workers of the (now closed) Fiat plant of Termini Imerese that represented the part of the population hardest hit by deindustrialization of the area (Fiat workers Focus Group). Each focus group lasted around an hour and a half. All groups were balanced by gender. The focus group discussions was later fully transcribed and prepared for textual analysis. Thematic content analysis focusing on key themes of the debate was conducted in the same way on the transcripts from all four focus groups. The analysis of the transcripts was entirely qualitative and attempts to quantify answers or fragments of dialogue would not have been appropriate.

We have organized the presentation of the result of our research in a way that combines the outcomes of both the quantitative and qualitative parts in terms of the key themes explored. The analysis reported upon in this paper is explorative and for the most part descriptive.

[2] The sample was calibrated by (i) gender (52% females, 48% males), (ii) age (27% 18–34 year-old, 36% 35-to-54 year-old, 37% 55 year-old or older), (iii) education degree (no degree, 6.3%, lower school 15.3%, 35.3% middle school, 33.3% high school, 10% university degree), (iv) size of the town of residence (28% living in towns of up to 20 thousand inhabitants, 32% living in towns between 20 and 100 thousand inhabitants, 40% living in towns of more than 100 thousand inhabitants), (v) job condition (entrepreneurs/manager, 5.0%, retailers, 3.3%, artisan/craftsman, 1.5%, employees/teacher, 15.5%, industrial worker, 9.3%, housewife, 22.8%, students, 8.5%, retired, 26.8%, unemployed, 7.5%).

[3] The survey was composed by 12 questions: (1) How urgent do you consider energy questions?; (2) Which one of these technologies will have positive, negative or no effect on our way of life in the next 20 years?; (3) How important are these actions for the next 20 years?; (4) Talking about the energy that power your home, how are you informed on…?; (5) Have you ever heard about geothermal energy?; (devil) How risky/useful/to be encouraged could be geothermal cultivation for your community?; (7) How worried would you be about the installation near your home of the following technologies?; (music) Would you install a heat pump in your house?; (9) How competent are the following actors about energetic choices?; (10) Talking about geothermal energy plants, would you like to have more information on…?; and (11) How much do you trust the following as information sources?

[4] We opted for a very openly conducted discussion, but we also identified some key points to be addressed (e.g. geothermal energy technologies, renewable energies, occupational issues, environmental issues, socio-economic development). Some very basic notions about geothermal applications (high/low enthalpy) were given to participants in a ppt presentation.

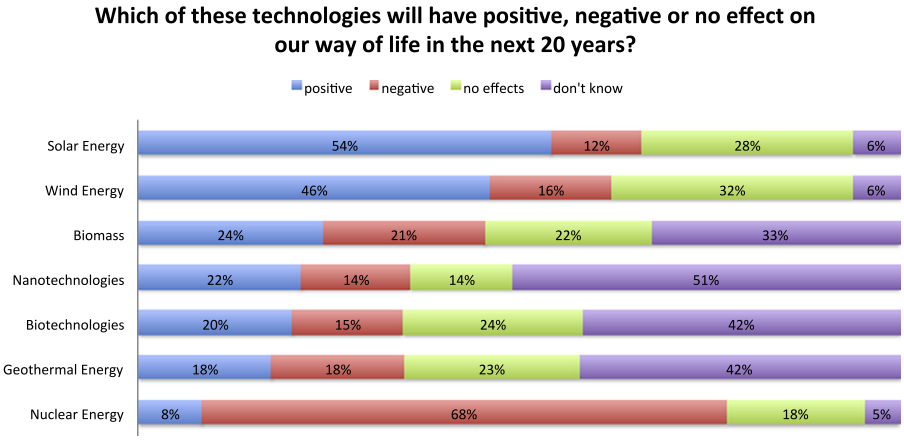

Fig. 1. Optimism about technologies.

3. Results

3.1. Views on energy issues including geothermal energy

Technologies harnessing different sources of renewable energy, solar and wind, are positively viewed by the general public in the Palermo area. When asked if given technologies will improve our ways of life in the next 20 years, 54% of the respondents answered that solar power and 46% for wind power would have a positive effect. Respondents offered very different views on nuclear power: 8% thought the effect would be positive, while 68% saw the effects as negative (Fig. 1). Public opposition to nuclear power appears to be deeply entrenched and the public does not seem to be ready to replace fossil fuels with just any other source available.

However, views on geothermal energy technologies seem less formed than views on solar, wind, and nuclear energy as indicated by high levels of "don't know" answers. Those who expressed a view were evenly split between positive and negative, 18%, while 23% think it will have no effect. Interestingly, levels of uncertainty for geothermal energy at 42% are very similar to the levels of uncertainty for technologies such as biotechnology that have been quite controversial in Italy. Levels of uncertainty are highest for nanotechnology that does not appear to be well known to the public of Palermo. These two technologies were included in our questionnaire for comparative purposes only, as a proxy for eventual controversy potential.

Participants repeatedly discussed geothermal energy in comparison with other energy options. "*We should not use one but many sources [of energy], a better use, I think, is this geothermal because it seems to be better because photovoltaic uses many square meters so vast areas of land are needed*" (ex-Fiat workers focus group). The issue of being independent from other countries, also in terms of energy safety, was a salient theme in all the focus groups "*I think this is important today, because the fact is that now everything is fueled from Algiers, practically we are dependent for supply of primary methane gas resources, so if there is a conflict, if something serious happens, then it is fundamental that alternative energy can be harnessed*" (Citizens focus group).

3.2. Knowledge, concerns and hopes on geothermal energy

The acceptance of the installation of energy technologies was explored in more detail by comparing geothermal to other technologies. When asked how worried they would be about the installation of different energy plants respondents were least worried about wind and solar farms, followed by geothermal power plant, heat pump and biomass, but greatly worried about nuclear power plants (Fig. 2). This emerges evidently also in the focus group discussion: "*Between nuclear and geothermal, I think that geothermal energy would be better*" (Fiat workers focus group).

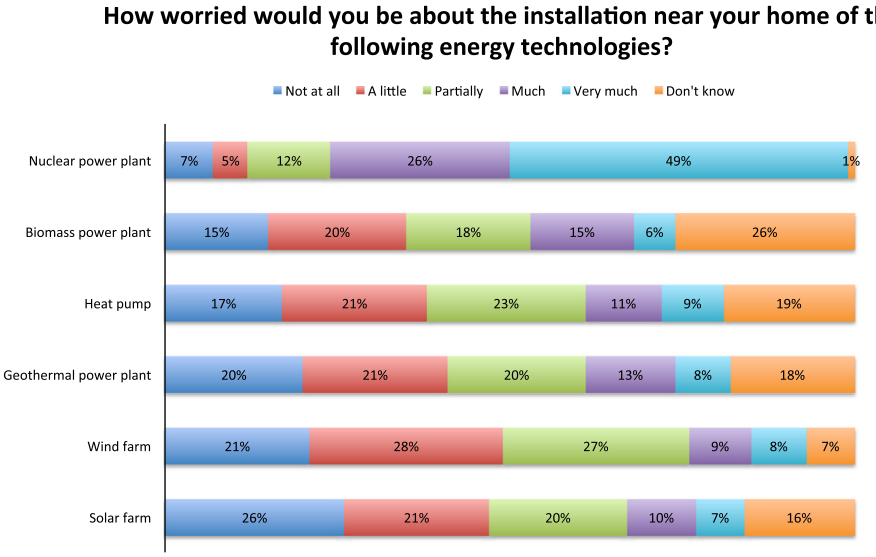

Fig. 2. Levels of concern about the installation of different plants for energy exploitation.

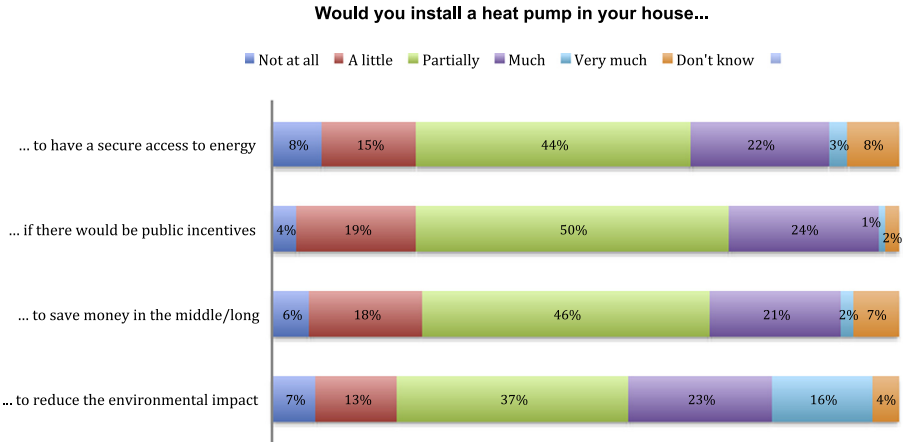

Fig. 3. Reasons for installing a heat pump at home.

Survey results show high levels of uncertainty over geothermal energy as only 17% of the respondents answered positively to the question "Have you ever heard about geothermal energy?". This finding is all the more striking considering that the area has benefitted from geothermal resources throughout the centuries, for example hot springs and thermal baths.

In comparison with the respondents of the survey, the focus group participants were somewhat more optimistic about geothermal energy and considered eventual further developments with lively interest. "*If geothermal energy is good, why not? First, to reduce health risks, second to save money on the bill*" (Citizens focus group). Nevertheless, the level of uncertainty, surely further accentuated by lack of knowledge, is high and more information about geothermal technologies is needed as participants made clear: "*To say if we are in favor of this kind of energy exploitation, we need to have all the information to balance pros and cons*" (Students focus group). The same holds for learning from experiences elsewhere "*If in Tuscany they already have this kind of plants, Sicily could be inspired by the experience of that area*" (Citizens focus group). Participants also raised some concerns over geothermal energy "*But it must said that this is not a clean source of energy, because if you go and extract sulphur compounds from the soil, and if above there is a park, then the park is no more. Because the ground is full of sulphur compounds and acids, we should be careful before we say it is a clean source. It is clean and renewable because you do not pay for the source*" (Stakeholders focus group).

Comparing the results from the quantitative and the qualitative components, the research indicates that the reasons for the apparent low levels of environmental concern could be due both to the general perception of geothermal as a low emission and green technology and the presence in Termini Imerese of the (now closed) Fiat automobile plant: "*The damage on the land has already been done… Since the industrial area is there, we could use it to develop new social opportunities*" (Students focus group). Participants also discussed the new horizons for social innovation in the area that might be enabled by harnessing a new source of energy: "*Termini Imerese has already an industrial area which is becoming a ghost town. We should convert it instead of leaving it empty*" (Citizens focus group).

We also explored what the reasons might be for installing heat pumps in respondents houses. When asked "*would you install a heat pump in your house if…?*", the prevailing reason was "*to reduce the environmental impact*". The second reason was "*to have a secure access to energy without depending from other countries*", the third reason was "*if there would be public incentives for this kind of investments*" and the last reason was "*to save money in the middle/long term*". The rate of "I don't know" answer was quite low for each type of motivation (Fig. 3).

3.3. Trust and information

The survey included a couple of questions measuring perceived competence and trustworthiness of actors. The actors perceived as being the most competent in making energy choices are, in descending order, scientists and researchers, local administration, the EU, national government, citizens and energy companies (Fig. 4). However, for the last three on this list of actors the percentages of answers of "partially competent" was quite high.

When asked about the trustworthiness as sources of information of some of the same actors a very different picture emerged (Fig. 5). Respondents who put their trust in Universities and energy companies well outnumbered those who do not. In other words, while universities and scientists were seen as both competent and trustworthy, energy companies were seen as trustworthy sources of information while being considered as not particularly competent on energy choices. Local administration was considered somewhat competent but those who expressed low levels of trust in those institutions well outnumbered those who expressed trust. An interesting paradox of seemingly contradictory views that held for perception of the EU as well. National government was seen as competent but respondents are equally split on its trustworthiness. Finally there appears to be some skepticism about the trustworthiness of journalists.

Focus group discussions clearly showed that energy management was perceived as very politicized, and major concerns over fair development of power plants rise from lack of confidence towards public institutions. "*We are badly administrated*" (Citizens focus group). Strategic choices about energy provision necessarily involve government decisions that impact local communities, and thus trust in public institutions becomes essential. According to our focus group, the distrust in politicians seem to be mainly caused by the perception of a lack of objectivity, fairness, honesty and demonstration of care. "*We lack a culture of the common good*" (ex-Fiat workers focus group). The business and economic interests associated with the energy sector were perceived as inevitably and strongly connected with financial speculation, corruption, and mismanagement. Participants strongly argued that political choices (also in the energy sector) were determined by interests far removed from the people's needs: "*Politics depends on excise tax on fossil fuels*" (Citizens focus group). Some of the politicians identified path-dependency of the socio-economic system from the fossil fuel model as a barrier to innovation in the energy sector: "*If*

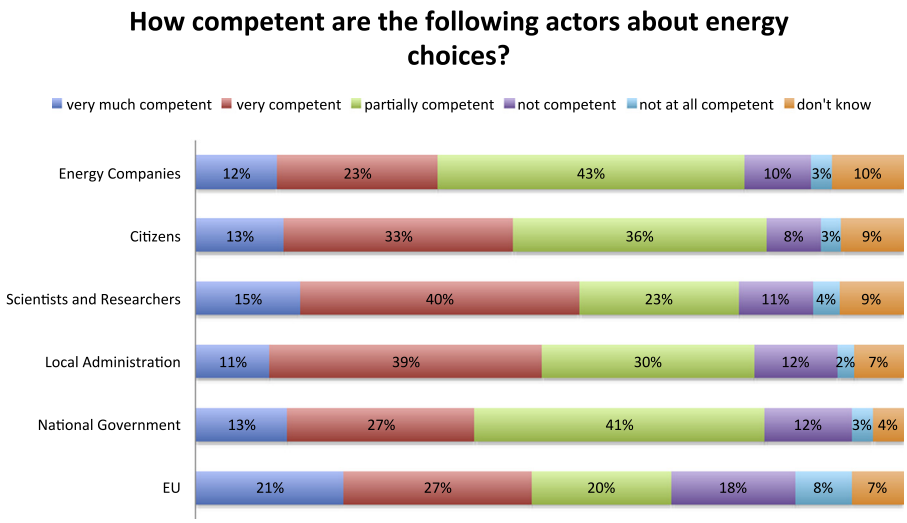

Fig. 4. Levels of competence of different actors in energetic choices.

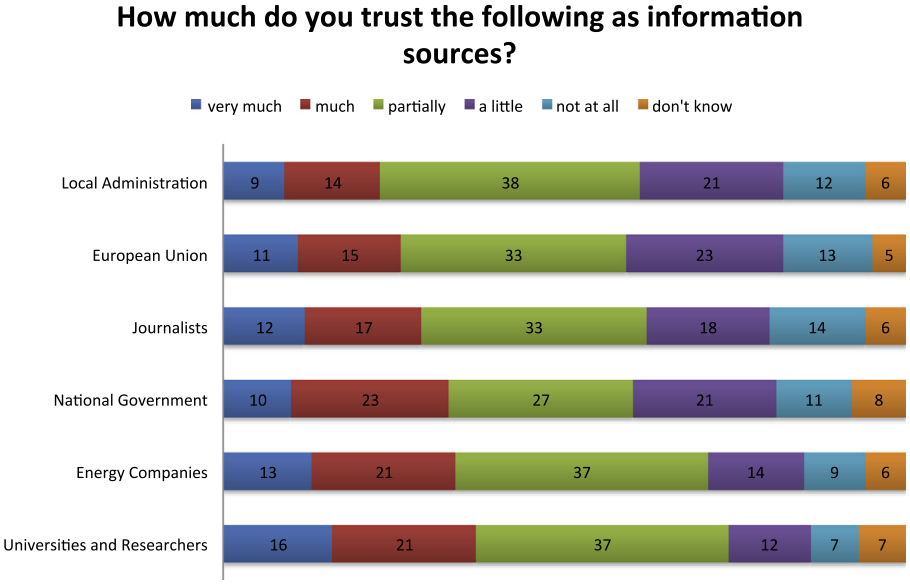

Fig. 5. Trust in information sources.

we build enormous infrastructure such as the Green Stream pipeline,[5] *it is quite obvious that we have a very rigid system and so if we want to introduce alternative sources of energy we have structural barriers*" (Stakeholders focus group). Politicians and stakeholders also identified some bureaucratic problems in the feed-in tariff law: "*The Conto Energia*[6] *was a good political tool developed in order to promote renewable energies, but there have been so many changes in a so short time, that entrepreneurs were confused about the best way for their investments*" (Stakeholders focus group).

Focus group participants cited the past experience of wind plants construction as an example of bad administration: "*Geothermal heat exploitation is a good idea, but we saw how it worked for wind farm: they took money from energy subsidies but many plants are not working*" (Citizens focus group). This is a reference to a scandal surrounding inappropriate use of public funds. The lack of confidence in politicians seemed exasperated by the perception that public institutions are, at times, intricately interrelated with organized crime and far removed from beneficial effects for citizens: "*There are too many interests of political and Mafioso order*" (Citizens focus group).

Focus group participants called for greater involvement of Sicilian citizens in local land management and energy policy decision-making. Moreover, we repeatedly observed assertions of a strong Sicilian identity: many participants mentioned local interests in contrast to national ones: "*Sicily is under the heel of Italy. We are considered as a holder of votes*" (ex-Fiat workers focus group). Participants asked for direct benefits for Sicilian people as an essential condition for the exploitation of geothermal energy on their land: "*It is better to exploit renewable resources than the fossil fuels. What is important is that Sicily has its return. The geothermal energy of Sicily belongs to Sicilians*" (Students focus group). The feeling that "*The problem is that Sicily has always been a land where people speculated, where in every possible way Sicilian citizens have been cheated*" (Citizens focus group) was a variation upon a theme in all four focus groups. The technical ability of politicians to

[5] The Green Stream is the gas pipeline that connects Italy to Libya.
[6] Conto Energia is a feed-in tariff system developed in Italy from 2005 to 2013.

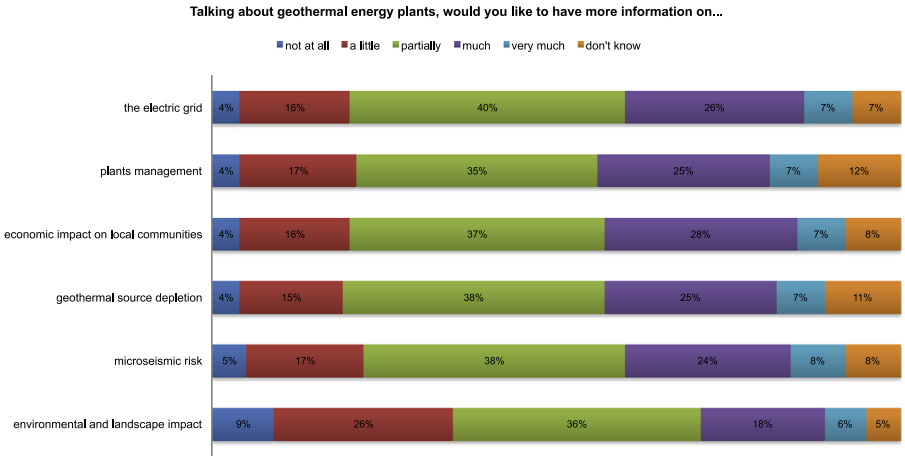

Fig. 6. Information required on geothermal plants.

develop a set of tools functional to a good administration was highly criticized: "*Bureaucracy is too slow*" (ex-Fiat workers focus group). Scientists seemed to be considered trustworthy both in terms of competence and in the values component of trust: "*We can meet and talk about it, but we are not experts. Researchers should find the right place for development and go there and illustrate opportunities*" (Citizens focus group).

Appropriate information is an essential condition for any meaningful public engagement activity. Focus groups participants were quite proactive and came up with interesting suggestions such as including energy and environmental issues in education programs, from primary school to universities: "*I work in the schools and we never talk about renewable energies. School offers circumscribed initiatives and we miss a long term plan on environmental education*" (Stakeholders focus group). Further, "*Environmental law is not included in the programs of Sicilian law faculties*" (Stakeholders focus group). It is interesting to note that "ignorance of the people" was perceived as a tool used by distrusted institutions to exercise power without engaging the citizens: "*What I see is widespread ignorance and no efforts are made to overcome this ignorance. In my opinion, politics works better in ignorance and that's why they want to keep this situation*" (Stakeholders focus group).

When asked what kind of information about geothermal energy they would like to receive, the survey respondents reported more interest in information on the economic impacts on local communities, the management of plants and resources, the electric grid and micro seismic risks, than in environmental and landscape impact (Fig. 6). Respondents lament the fact that available information about energy issues is mostly provided by the energy companies themselves and ask for interlocutors without conflicts of interest. "*We lack public information, which is different from marketing information*" (Citizens focus group). This theme emerged in the discussions of all groups, even in the group of policy makers and industry.

4. Discussion

Our research, funded by the Italian government, is one of few studies that explicitly deals with the conditions necessary for public engagement processes in the exploration of further developments of geothermal energy by studying levels of public acceptance. Our results clearly show that the question of energy provision is perceived as very important and highly political issue.

4.1. Comparison with other studies

Similarly to the case study conducted by Carr-Cornish and Romanach (2012) and Dowd et al. (2011) in Australia, we found that participants in consultations are open to geothermal technologies, but in general they were unable to distinguish between the different types of geothermal resources and applications. Further, doubts linger over the engineering of geothermal systems and the potential negative impacts. There were both similarities and differences in the concerns expressed by participants: worries about eventual seismic activity instigated by geothermal drilling were voiced both in Australia and in Southern Italy, while the concerns about the water usage prominent in discussions in Australia seem less salient for the Sicilians.

The results of the Greek case studies described by Polyzou and Stamataki (2010) were somewhat different. First, general knowledge about the geothermal energy issue seems to be much higher than for the Italian and the Australian case studies (reaching a peak of 100% for the under 40 years-old on the island of Nisiros). Second, the main reason for concern was air pollution rather than soil and ground water pollution.

It is interesting to compare the results of our survey with some of the results from a recent Eurobarometer survey that included questions similar to ours, not on geothermal energy, but on solar, wind and nuclear energy (Gaskell et al., 2010, 2011). While 87% of the European and 81% of the Italian respondents viewed solar energy positively, only around 54% of the respondents of the province of Palermo did so. The same pattern holds for positive views on wind energy (84% of Europeans, 74% of Italians, and 46% of our sample) and nuclear energy (39% of Europeans, 34% of Italians, and 8% of our sample). Our respondents clearly hold views about energy technologies that differ from the European and Italian average and the results from the qualitative part of the study are very helpful to understand the possible reasons. Further, views on other technologies included in the survey followed a similar pattern. For biotechnology, positive views on European level were 53%, 52% for Italy but 20% in Sicily. For nanotechnology, positive views were 41% for Europeans, 36% for Italians and 22% for the Sicilian sample. Don't know answers were also much more frequent in Sicily. In other words, the comparison between our results and the Eurobarometer survey results indicates that the views of the residents in the province of Palermo on energy technologies and innovation appear rather more diffident than the Italian average. That raises the question over the reasons that might be doubt over given technologies or innovation in general or distrust due to other factors. Further, this highlights the difficulties when extrapolating from the findings of single localized case study

to wider communities.

4.2. Levels of public acceptance and trust

Levels of acceptance of geothermal technologies, as measured by the survey, are rather balanced between those who express a favorable opinion and those who do not. However, the percentage of the undecided is very high and that may be interpreted as public opinion potentially swinging either way as eventual developments unfold. Further, at the moment this uncertainty shrouds geothermal technology in something of a conflict potential – if there are actors that strongly influence the future agenda (Torgersen and Hampel, 2012). That is actually the case now in agricultural parts of Southern Tuscany where interested groups have coalesced to form a movement against further developments of geothermal energy, that situation is in something of a stalemate and new solutions are being sought.

The findings from the focus groups were very valuable for a better understanding of the reasons for the apparent diffidence of the public in the Palermo area. Questions were raised over the relative risks and benefits of energy technologies in general and geothermal energy in particular, however, it was evident in the discussions of all four focus groups that concerns over adequate management of developments were the main source of misgivings. For instance, the costly construction of wind farms in Sicily that is not functioning, was frequently mentioned. The issue of trust in the actors responsible for technology development is clearly a decisive factor. The results from the survey and the focus groups converge towards an apparent trust paradox; actors might be perceived as being competent, (see Section 3.3) but not necessarily worthy of trust. These findings are not particular to Sicily as the dual component model of trust is well documented in the literature (Poortinga and Pidgeon, 2003; Siegrist et. al., 2003). Distrust in current systems of innovation might be also reinforced by the sense of "path dependency" of the carbon locked-in societies (see Lehmann et. al., 2012).

4.3. Innovation and place attachment

The NIMBY concept does not capture the spirit of our results, just as many other researchers have found in recent years (see Devine-Wright, 2011b; Wolsink, 2012a). Conversely, the concept of "place attachment" (Devine-Wright and Howes, 2010) is very useful for interpreting the findings of this case study. For the participants in the focus groups, eventual geothermal developments were considered in terms of re-definition of an area that is undergoing rapid deindustrialization with the view of increasing opportunities for employment and further wellbeing.

The controversies over technology developments were framed as politics and management. In other words, innovation is not perceived to be problematic as such, it is the management of the process that leaves a lot to be desired by the local citizens. Participants in the focus groups expressed a strong sense of Sicilian identity with ancient roots and a long history of adapting to change. That very same sense of identity was the basis for discussion about appropriate ownership and management of local resources. Italian administration has become increasingly regionalized in recent years and the South is lagging behind the more affluent North in terms of development and innovation, at times creating tensions in national politics that our respondents clearly resent.

4.4. Communication, consultation and public participation

The discussion about the results of this case study would not be complete without careful considerations about the study as a public engagement exercise. The aim of this research was to explore public views and acceptance of geothermal energy developments in a well defined area of Northern Sicily. The framing of the research corresponds to socio-political acceptance, the first of the three dimensions of social acceptance of renewables as defined by Wüstenhagen et al. (2007). Drawing upon the tri-partite distinction between mechanism of public engagement provided by Row and Frewer (2005) the study is best described as a public consultation exercise. However, the findings of this give some important insights into how this particular public would like to engage with the issue of eventual development of geothermal energy.

Levels of knowledge about geothermal energy are low and participants in the focus groups expressed rather clear views on the lack of balanced communication and information available. The participants in the focus group were open to geothermal and the discussion became very lively at times. Although most participants were no experts in the field, they got a handle on the main issues without many difficulties. A very common theme was that people were simply not properly informed about this technology but participants made a distinction between the marketing information provided by the energy companies, and public communication and information, that they believe is lacking, on the scientific aspects, costs, risks and benefits. This is a strong message to the international geothermal community. Our results show that fostering citizens participation in policy making processes, which is strongly encouraged by RRI agenda of the European Union (Owen et al., 2012), would be much appreciated by the people of the province of Palermo.

Our participants clearly have much to contribute to the debate over energy policy and did appreciate the chance of having a voice, but in general they did not feel prepared enough to have a decisive role in the decision making process at the moment. A concerted communication strategy is needed to foster reasoned and informed public debate in policy making processes. Public participation in science policy in Italy is work in progress at the moment with the notable exception of national referenda, such as the 2011 one against privatization of water resources and nuclear energy that both resulted in a ban (Allansdottir and Veltri, 2011).

5. Conclusions and policy implications

5.1. Conclusions

This case study was an exercise with public engagement on the issue of eventual development of geothermal energy in the province of Palermo in Sicily. It was an attempt at "upstream" public engagement as it was conducted while studies on the scientific and engineering feasibility was being carried out in the area. In terms of the development of renewable energies, management and acceptance, geothermal technologies are particularly interesting for several reasons that open up challenges for innovation in policy making. First, geothermal energy involves several components of the Earth systems: the subsoil, the water and the atmosphere. Second, geothermal energy development can be encouraged both as centralized geothermal power plants and as heat pumps distributed systems, whose development requires an exit from the path-dependency of current carbon locked-in system and significant changes at the institutional, social and economic level.

The results of our case study indicate that there is some optimism about the prospects of geothermal energy cultivation. However, levels of uncertainty amongst the public in the area are high and levels of knowledge are low. The issue might well have the potential for future controversy. Distrust in the innovation system on a local level, rather than concerns of the technology

itself, is a major barrier for eventual developments. Participants much appreciated taking part in the discussions and were clearly supportive of initiatives that seek to foster public engagement in policy making processes. It might be worth pointing out that the research was conducted few months before the Italian national election that saw a new political movement, the 5Star[7] movement, take 25.5% of the vote on a national level but 33% of votes in Sicily.

5.2. Policy implications

Successful implementation of geothermal development policies clearly needs careful design of sensitive future public participation activities to facilitate putting the energy innovation process on a socially sustainable path. Such an undertaking would face some major sets of challenges. First, low levels of knowledge and high levels of uncertainty are a fertile ground for controversies, in particular when citizens feel alienated from the policy making processes and distrust key actors. Therefore serious efforts should be put into balanced public communication activities on scientific, social and economic aspects between all stakeholders and citizens, from the onset of eventual development. Second, public views on geothermal technologies might differ between locations, cultures and countries and opinion on those issue might be somewhat volatile. Sensitive monitoring of local public opinion during developments would give valuable feedback. Third, as lack of trust in policy making processes appears the most important barrier for innovation, more efforts should be made to design and to create transparent deliberative spaces with diverse publics at every stage of the innovation chain. The success of such activities will evidently depend upon participants gaining a real sense of their voice being heard and that their hopes and concerns being adequately addressed and embedded in further developments. Finally, after a period that saw public engagement activities being encouraged, at the EU level at least, there is evidence of something of a backlash. For example the recent Italian national law called "Sblocca Italia", intended to facilitate innovation in the country, has been contested and described as antidemocratic, centralizing decision-making processes. It is now up to researchers themselves to make sure that public engagement activities are designed in ways that go beyond token gestures and generate sensible and credible input into policy making processes.

5.3. Further research

The case study presented here was an attempt to be responsive to the concerns of a particular community, as each territory should be treated as unique by designing sensitive, localized, and *ad-hoc* analyses that give a voice to local citizens. Another case study on the same issues, applying the same methodological approach but in a different location in Italy has already been conducted. Numerous public engagement initiatives in technology policy making have been carried out across the globe in recent years and the literature offers a variety of case studies on public engagement. However, although a proliferation of case studies is interesting and worthwhile we also need to design appropriate frameworks under which such case studies can be systematically analyzed, compared and contrasted also in terms of the impact on policy making processes (O'Doherty and Einsiedel, 2012). For an example for such an approach in the study of public discourse on biomedical science see Hansen and Allansdottir (2011). Finally, this research has been characterized by the strong and productive cross disciplinary approach to the whole question of the development of geothermal energy in the Southern Italy that can hopefully inspire studies on energy policy that include the views, hopes and the sentiments of the local communities.

[7] The Five Star Movement is a political party in Italy started by Beppe Grillo, a popular activist, comedian and blogger, and Gianroberto Casaleggio, a web strategist, on 4 October 2009. M5S is considered populist, anti-establishment, environmentalist, and Eurosceptic party that experiments with new forms of public participation also with skillful use of social media.

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