Energy Policy xx (xxxx) xxxx–xxxx

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Geothermal energy and the public: A case study on deliberative citizens' engagement in central Italy

Anna Pellizzone[a,c,*], Agnes Allansdottir[b], Roberto De Franco[c], Giovanni Muttoni[a], Adele Manzella[d]

[a] Università degli Studi di Milano, Dipartimento di Scienze della Terra 'Ardito Desio', via Luigi Mangiagalli 34, I-20133 Milano, Italy
[b] Fondazione Toscana Life Sciences, Via Fiorentina, 1, 53100 Siena, Italy
[c] CNR, Istituto per la Dinamica dei Processi Ambientali, Via Mario Bianco 9, 20133 Milano, Italy
[d] CNR - Istituto di Geoscienze e Georisorse, Via Moruzzi 1, I-56124 Pisa, Italy

ARTICLE INFO

Keywords:
Geothermal energy
Public engagement
Social acceptance
Common goods
Trust
Italy

ABSTRACT

This paper reports on a case study on the citizens' engagement with developments towards the harnessing of geothermal energy in central Italy. The research has been conducted within the framework of a larger project on the feasibility of further geothermal developments in Italy, funded by the Italian government. The aims of the case study research were first to explore the role of public and stakeholder engagement in the processes of innovation in the geothermal energy sector. Second, to design, implement and consolidate a methodological framework for comparative analysis of case studies on citizens' engagement, thus bringing a social scientific perspective into geothermal energy research. The results show general support for renewable energy but knowledge and understanding of the potential of geothermal is remarkably low. Lack of trust in politics and unsure public communication emerged as prominent themes where the common good and community developments are sharply contrasted with corporate and private interests. As geothermal energy is included and encouraged under the European Strategic Energy Plan and in the Paris agreement on halting climate change, the results can make significant input into future policy making, by providing concrete guidelines on citizens' engagement in processes of culturally sustainable innovation.

1. Introduction

1.1. Geothermal energy in Italy

Accessible geothermal resources have been used for more than a century for direct use (heating and cooling) and for indirect use (electricity generation by power plants). Geothermal technologies are currently producing base load electric generation in 24 countries (12.6 GW of installed capacity, see Bertani, 2015) and are used directly for heating and cooling in 78 countries, generating 163.7 TWh/yr of thermal energy in 2015 (Lund, 2015), with geothermal heat pump (GHP) applications having the widest market penetration. Thanks to recent technological development it is estimated that future geothermal deployment could meet more than 3% of global electricity demand and about 5% of the global demand for heat by 2050 (Goldstein et al., 2012).

Currently, geothermal energy is considered a strategic and sustainable resource that can help with putting societies with access to such resources on the path towards a decarbonised future, as articulated in the European Strategic Energy Technologies Plan.[1] Worldwide, a new Global Alliance on responsible development of geothermal energy was approved at the Paris summit on climate change.[2] In the light of these recent developments community engagement with geothermal energy is clearly of prime interest.

Geothermal technologies are considered to be environmentally advantageous because they don't need combustion process emitting carbon dioxide (CO_2), with the only direct emissions coming from the underground fluids in the reservoir. Local hazards arising from natural

* Corresponding author.
E-mail address: pellizzone.anna@gmail.com (A. Pellizzone).

[1] The European Strategic Energy Technology Plan (SET-Plan) was defined in 2015 with the aim to accelerate the development and the deployment of low-carbon technologies. It seeks to improve new technologies, promote research and innovation, bring down costs by coordinating research and helping to finance projects. It also promotes the cooperation amongst EU countries.http://ec.europa.eu/energy/en/topics/technology-and-innovation/strategic-energy-technology-plan

[2] At a global level, in the context of the 21st Meeting of the Conference of the Parties of the United Nations Framework Convention on Climate Change in Paris, a coalition of 38 countries and over 20 development and industry partners joined forces in the Global Geothermal Alliance. The GGA is a platform for enhanced dialogue and knowledge sharing within the constituency as well as for coordinated action to increase the share of installed geothermal electricity and heat generation worldwide.

http://dx.doi.org/10.1016/j.enpol.2016.11.013
Received 10 May 2016; Received in revised form 28 September 2016; Accepted 5 November 2016
Available online xxxx
0301-4215/

phenomena, such as micro-earthquakes, may be influenced by the operation of geothermal fields, but they seldom reached levels high enough to lead to human injury or relevant property damage, and the expertise developed in such cases should be sufficient to prevent similar events in the future. Climate change is not expected to have any major impacts on the effectiveness of geothermal energy use, and the widespread deployment of geothermal energy could actually play a meaningful role in mitigating climate change.

Current levelized costs of heat (LCOH) from direct uses of geothermal heat are generally competitive with market energy prices, and levelized costs of electricity (LCOE) are relatively low. However, geothermal projects have relatively high upfront investment costs. High-temperature geothermal resources are already economically competitive with market energy prices in many locations but have restricted geographic distribution. To support the development of lower-grade hydrothermal resources, which are widely distributed, public and private support for research along with favourable deployment policies may be needed.

Although geothermal energy has the potential to provide long-term, secure base-load energy and greenhouse gas (GHG) emissions reductions with minimum and manageable environmental risks, it currently enjoys only modest growth per year with respect to solar or wind technologies.

From ancient roman thermal baths to the construction of the first geothermal power plant in Larderello (Borzoni et al., 2012), Italy has historically played a leading role in the cultivation of geothermal resources, and 25% of the energy demand of the Tuscany Region comes from geothermal resources. Italy has recently experienced controversies over the further development of geothermal resources for energy production, an on-going dispute over the development of the Monte Amiata (southern Tuscany) geothermal field. The issues raised regard potential risk to human health and the environment but questions are also raised about the adequacy of the technologies and infrastructures in place for the harnessing of geothermal resources (Bravi and Basosi, 2014).

In order to characterize, classify and map the conventional and non-conventional geothermal resources of Central and Southern Italy and to understand the eventual reasons for opposition or support to geothermal technologies, the Italian National Research Council conducted a research project “AtlanteGeotermico del Mezzogiorno”. As energy issues and policies strongly impact society the project also includes studies on the assessment of social acceptance.[3] This project is an important opportunity for two main reasons: (1) recent interest in the use of geothermal technologies using different enthalpy levels of geothermal resources has increased, however knowledge and understanding of the potentials of this renewable energy source and its implications for the general society seems to be rather low; (2) geothermal technologies and their impact on society are particularly interesting since they cross a variety of questions: environmental (i.e. water usage, drilling and exploitation risk, gas emissions), socio-economic-political (i.e. procedural and distributional justice, public engagement in science, carbon lock-in debate, costs) and innovation-related (smart grids, the role of prosumers, new geothermal technologies).

1.2. The New Energy Societies framework

Recently, many authors have pointed out that the social sciences still play a relatively minor role in energy research (Pidgeon et al., 2014; Stirling, 2014; Sovacool, 2014). “Energy advocates, the climate change community, and related policy makers need to recognize that energy production, consumption, and policy are both social and technical domains” (Sovacool et al., 2015, p. 95) and society plays an active role in either accelerating or preventing the development of new energy technologies. Carefully designed and conducted public engagement activities are examples of the contribution of the social sciences and are based on the assumption that research and innovation (R & I) can gain important input and insights from societies and communities in terms of their hopes, concerns, needs, resistances, knowledge and experiences. As Sheila Jasanoff has eloquently written (2004, p. 5): “the need for a generative discourse for discussing the role of science and technology in society is abundantly clear. What happens in science and technology today is interwoven with issues of meaning, values, and power in ways that demand sustained critical inquiry”. Science impacts on society as well as society impacts on science: “in a word, [science and society] are *co-produced,* each underwriting the other's existence” (Jasanoff, 2004, p. 9). This is particularly pertinent for renewable energy technologiesthat (1) require sustained and diffuse efforts from all stakeholders (public, investors, governments) and (2) need to overcome a series of technical, economical, cultural and political barriers posed by the energy system in which we live in, which is mainly locked in on fossil resources (carbon-oil-gas; Lehmann et al., 2012).

Implementing research and innovation programs with social scientific research is vital for a culturally sustainable development of energy technologies, and in this respect, opposition to new developments should neither be approached by a deficit model of public understanding of science, nor regarded as phenomena driven by selfishness, ignorance or irrationality (Batel and Devine-Wright, 2015). The motivations and the mechanisms underpinning social behaviors and attitudes should instead gain centrality in the innovation process itself, and conceptual frameworks that assume a top-down approach in innovation -such as the Nimby hypothesis - should definitively be overcome (Breukers and Wolsink, 2007) More nuanced concepts such as place attachment have been proposed (Devine-Wright, 2011) but still rest on the tacit assumption that only opposition to developments is a worthy object for social scientific research. Rather, researchers need to take a broader view on community engagement with technology innovation, taking into account issues such social trust that plays a pivotal role in social and community acceptance of technology development (Bell et al., 2005; Gross, 2007, Greenberg, 2014).

Similarly, innovation policy becomes a matter regarding all social actors in which careful and sensitive forms of public engagement are required. Public engagement is not only a matter of R & I improvement, it is an essential feature of democratic decision making processes. See Fishkin, (2009) and Thompson (2008) for detailed discussions of the processes of deliberative democracy; Hagendijk and Irwin (2006) and Wilsdon and Willis (2004) for a discussion of deliberative public engagement. Although the literature on public engagement with geothermal energy and new deliberative exercises on the energy issue are rapidly growing, contemporary literature on social issues relating to the development of energy technologies risks to become an unfertile list of disconnected studies (Stilgoe et al., 2014). A first case study on the views of stakeholders and local communities on harnessing geothermal resources in southern Italy was reported by Pellizzone et al. (2015); in this paper, we report on a second case study from central Italy using the same methodological approach.

1.3. Geothermal energy and social acceptance: a short literature review

The literature on the social acceptance of geothermal energy is still scant but growing on a global scale. First of all, public views on uses and developments of the geothermal energy are highly differentiated, in fact attitudes evolve over time and vary across places. For instance, concerns about eventual risks related to the activities of geothermal harnessing are strongly place-related: in Australia (Carr-Cornish and

[3] This is also in line with the recent innovation policy approach by the European Commission termed Responsible Research and Innovation (Owen et al., 2012; Van der Hoven, 2013; Von Schomberg, 2013),