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Perspectives

Contested deep geothermal energy in Germany—The emergence of an environmental protest movement

Conrad Kunze[a,*], Mareen Hertel[b]

[a] Helmholtz-Zentrum für Umweltforschung—UFZ, Department Stadt- und Umweltsoziologie, Germany
[b] Martin-Luther-Universität Halle-Wittenberg, Germany

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ABSTRACT

Geothermal Energy is regarded an important element of many future scenarios of 100% renewable energy. Besides biomass, hydrodams and wave plants, geothermal can provide a steady base load of energy. While the technology received little attention compared to wind or solar for most of its history, this has significantly changed in Germany in recent years. Since an earthquake attributed to geothermal development in Swiss Basel in 2006, a risk discourse evolved in German language media reports. Subsequently local protest groups have been founded that establish a new environmental protest movement. According to the theory of vested interests (Kousis, 1993; Schnaiberg, 1993) and socially constructed risk perceptions (Douglas and Wildavsky, 1982) the future development of deep geothermal technologies will continue to be accompanied by strong conflicts of acceptance, that are likely to slow down its dissemination significantly.

1. Introduction

Deep Geothermal Energy (DG) is an old form of renewable energy. The first plant was installed in Italy in 1904 and produced at this time 220 kWh thermal energy. Since then many other plants have followed in regions with geological dislocations (zones e.g. with volcanic activity where hot reservoirs are available closer to the surface than usual). For most geothermal techniques, this dislocation is necessary and thus their range of application is limited. Newer techniques known as hot dry rock, hot wet rock, hot fractured rock, petrothermal DG, deep heat mining or enhanced geothermal system (EGS) depend to a smaller degree on these dislocations, some predict even an applicability anywhere, independent from dislocations. Porous rock has been the basic requirement for using hot underground water in DG. The technology became widely applied in some geological hotspots such as Iceland, Tuscany in Italy, the Geysers in the USA and Cooper Basin in Australia [1]. The principle is simple, a hole is drilled, usually between a thousand up to 5000 m to exploit naturally occurring hot water. Above ground it drives a steam turbine or is fed into a heating grid. With a second drilling the water is reinjected in the ground.

The geographical limitation of traditional geothermal systems restricted it to a minor role in the global energy provision until now. In 2004 DG supplied only 0.414% of the total primary energy supply and 0.4% of global annual electric power consumption ([2], p. 183), in 2012 the situation had not altered and no take-off of geothermal energy is in sight yet.[1]

However this is supposed to change dramatically according to some scenarios for a future of renewable energy provision that expect steep increases for the use of geothermal power [3–7]. The challenge of a provision with renewable energy baseload for 24 h 7 days a week can be addressed by DG, as proponents argue. The predicted take-off in the coming years shall mainly be made possible by technological improvement, to which we will refer here as EGS (see the listing above for alternative names). This involves foremost a method known from the gas industry, hydraulic fracturing. “Fracking” is often promoted as the technological panacea to reduce the dependence on limited natural geological conditions by creating the required porous rock formations artificially.

However as our findings indicate, social acceptance is crucial for the technology’s dissemination in Germany and probably in

[1] Also in 2012 geothermal contributed only 0,47% of the global primary energy supply and 0,3165% of electricity production. Own calculation: 153,59 PWh global primary energy consumption (http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=44andpid=44andaid=2andcid=ww,andsyid=2008andeyid=2012andunit=QBTU), 12,8% covered by renewable energies and 3,7% of them are geothermal; 22752 TWh global electricity production and 72 TWh production of electricity from geothermal (http://de.statista.com/statistik/daten/studie/166918/umfrage/stromerzeugung-weltweit-seit-1990; http://www.iea.org/topics/renewables/subtopics/geothermal/).

* Corresponding author.
E-mail addresses: conrad.kunze@ufz.de (C. Kunze), hertel.mareen@gmail.com (M. Hertel).

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other countries as well. Since a series of earthquakes began in 2006 in Switzerland caused by EGS, and continued with more seismic accidents caused by conventional systems in Germany, DG has significantly lost popularity in both countries as was indicated by a sea change in mass media reports that rather emphasize the technology's detriments than its benefits [8,9]. As we found out, a wave of local protest groups emerged in Germany, which can be interpreted as a new environmental protest movement. As it is steadily growing in numbers, the scheduled mass application of DG becomes much less likely. As our research shows, protests probably slow down or even stop DG development in what could be called local "environmental justice conflicts" [10].

In the next section we sketch the used methods, section three provides a brief overview of the used theories and section four gives a historical outline of DG related accidents and the protest movement. Section six locates DG in the German energy transition *Energiewende*. Section seven provides an overview of the turning point of public opinion and the emergence of the protest movement. In section eight statistical findings are interpreted with the two theories. In section nine impact of protests on the future of DG is discussed and section ten offers a conclusion and policy recommendations.

2. Methods

There was no other research available except the media studies and an unpublished qualitative work. We decided to pursue a quantitative approach, to gain an oversight of the local groups, their dissemination and to find statistical correlations. The studied period covers the time from 2006 (first major earthquake in Basel) to 2015 and is limited to Germany.

We first conducted an extensive online review between November 2014 and April 2015 to complete existing data (from the association of Geothermal Energy GtV) on running, planned and abandoned DG projects, the protests against those and the related seismic accidents. The GtV is a German lobby association with about 600 active companies and individual members mostly from industry, science and energy utilities. It offers the major dataset of existing DG projects in Germany. Nevertheless the data required numerous corrections and critical review, as we found some flaws seemingly stemming from an interest to portray DG as successful as possible, not mentioning canceled projects.

To evaluate protests we surveyed and indexed all internet pages of protest groups available, including facebook. By spending nearly one year time on the dataset, we finally came up with a dataset that we believe assembles a complete list of the locations, statuses, types and energy outputs of DG projects in Germany in 2015.

We identified local citizen initiatives against DG (LCI) by their internet presence, facebook groups or newspaper reports covering them, that were available online. Most LCI are part of quite active and branched networks, and refer to one another, which greatly helped us finding them. After several months of research we could not find new LCI and concluded searching.

We came along a few cases, in which a protest popped up, that even changed local politics, which was invisible before to our inquiry.[2] This happened only in few cases, and we hold it to be reasonable that most protest groups seek public recognition and thus have an online existence, or are at least reported about by newspapers (that usually make articles available online). Minding possible exceptions means that the real number of LCI is probably higher than our numbers indicate. However it is very unlikely that we missed any site of significant protests.

To draw a clear line between an informal group or people that are unhappy with a DG project and a proper protest group is of course to a certain degree a random choice. We decided to involve only groups that display some real political activity (in contrast to complaints in Facebook or a blog in the internet) and some local members that were active (in contrast to one person initiatives or declarations without active members behind). Furthermore we checked if internet pages were still updated, and if other sources (usually a newspaper) also reported on activities like public gatherings, meetings etc.[3]

A special case are villages and regions, that did not have an LCI because feelings of opposition and anger were already channeled into formal political forums, the local parliament, its parties or the administration. In some cases local councils voted against DG projects, without an LCI present.[4] We included these cases in a chart and a statistical analysis. We did not research further into formal local political processes, as this requires field research and a much higher effort. Possibly more local councils have voted against DG, than we know of, so the quota of regions in opposition (if council votes against DG are counted as such) might again be higher than indicated by our numbers. The real number of local protests is therefore likely to be higher than indicated in our data.

Seismic accidents were counted as any seismic activity close to a geothermal project site, with a likely connection of both. The connection of DG and seismicity was usually made by press reports, protest groups and administrations, and sometimes challenged by DG advocates. We relied mostly on media reports as indicators in the form of local newspaper's online articles. In Germany's dense media landscape it can be expected that no larger earthquake remains unmentioned by press coverage. However there is no official earthquake reporting scheme like in Japan, so data is incomplete and possibly smaller earthquakes remained unmentioned by news media and are thus missing in our statistics. The reported earthquakes had magnitudes between 2 and 2,4.

Our data analysis was supported by an unpublished qualitative study from a colleague, based on expert interviews and focus group discussion in two towns with DG projects, Meiningen and Bad Schleema, with a fierce conflict in the former.[5] Our interpretation of the data was informed by the theories of risk perception [11], vested interests [12] and one in depth single case study on a DG site in Greece [13].

3. The theory of risk perception and the theory of vested interests

Risks are socially constructed and gain relevance by social processes ([11], p. 186). Also a perceived need to act is only created if risks are defined as such in scientific and public discourses [14]. Douglas and Wildavsky assume that the selection of risks for public attention is not primarily based on the depth of scientific evidence or on the likelihood of danger but on the public discourse on hazardous issues ([15], p. 110; [11]). Socialized cognitive patterns work like filters in the evaluation of information about a risk [16]. Therefore, accidents alone do not necessarily lead towards a certain risk perception, they can however change the discourse on risk [17].

The second set of theories, Schnaiberg's "treadmill of production" and the theory of vested interests allow for an analysis of the development of a specific environmental conflict and to categorize the actors involved [18]. Schnaiberg offers an explanation of the

[2] E.g. in Neuried, 16.12.2014, http://www.bo.de/nachrichten/nachrichten-regional/wir-sind-versuchskaninchen.

[3] E.g. in Neuried, 16.12.2014, http://www.bo.de/nachrichten/nachrichten-regional/wir-sind-versuchskaninchen.

[4] E.g. in Bellheim, Rülzheim, December 2014.

[5] The qualitative data was kindly made available by our colleague Dr. Alena Bleicher at Helmholtz Center UFZ, Leipzig.