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**Report on public acceptance**

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**Authors:**

**Sören Reith, Thomas Kölbel, Pascal Schlagermann(EnBW Energie Baden-Württemberg AG)**

**Anna Pellizzone (University of Milan)**

**Agnes Allansdottir (University of Sienna)**

# **Public acceptance of geothermal electricity production**

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## 1. Executive summary

With the 20-20-20 goals the European Union has set ambitious goals for the decarbonisation of the European energy system. This landmark decision leads to a steady increase of renewable energy production in Europe. As a consequence, multiple decisions concerning the siting of renewable power plants have to be taken in the next decade. In the energy sector, there is a growing consensus that the integration of renewable energies into the European energy system cannot be reached with the opposition of the citizens. The consideration of social acceptance and the reasons for objection are thus indispensable for site selections in future.

In this report, a general introduction into the topic of social acceptance and associated topics like Responsible Research and Innovation is given. Firstly chapters 2 and 3 show that social acceptance has to be investigated on several levels. Success in project development can only be reached, if the circumstances on all levels support the implementation of renewable energies. These circumstances are mainly defined by the attitude of affected stakeholders. This includes the affected members of the public, policy makers and market actors. In the process of shaping this attitude, mass media plays a prominent role.

Therefore mass media in Germany was analysed. Leucht delivered in two studies (Leucht 2011); (Leucht 2012)) a picture of the mass media landscape in Germany. On the basis of this analysis, four main sources of social resistances were identified in chapter 4. Therefore the following environmental issues, “missing-involvement”-issues, financial issues and the NIMBY-syndrome are analysed. Therewith a general understanding of these topics is implemented. Through sound information prior to a social acceptance discussion, project developers can act open and provide information that helps to create trust. For the single issues it is demonstrated that on the one hand geothermal power faces similar problems as other renewables. But on the other hand geothermal power offers advantages in a social acceptance discussion like the project participation possibilities through the direct use of heat.

Through case studies on social acceptance in Italy, France and Germany (chapter 5) the reader has the possibility to learn from practical positive and negative examples. In this way, mistakes can be avoided and valuable resources can be concentrated on the development of geothermal energy.

Finally chapter 6 gives recommendations and best practice advices for the implementation of geothermal energy projects. The experience from practical and theoretical examination of this topic shows that social acceptance can only be reached through information, cooperation, participation and consultation.

## 2. Public Acceptance and its effects

The European energy system faces a dramatic transformation process. With the 20-20-20 goals, the European Union has set ambitious goals for the transformations of its energy system. A variety of legislative initiatives in the different European countries shall initiate this process. 20 % of the final energy consumption shall be supplied by renewable energies. The implementation of renewable energies and the transformation of the energy system will be influenced by different factors, one of which is assumed to be public acceptance (Hauff, et al. 2011), (Ekins 2004).

Therefore in the following the term public acceptance is introduced. Additionally this chapter gives examples for non-existing public acceptance and the consequences that arise through the so called social resistance.

Public or social acceptance was defined by (Wüstenhagen, Wolsink and Burer 2007) as a combination of three categories, socio-political acceptance, market acceptance and community acceptance. Figure 1 shows the so called "Triangle of social acceptance".

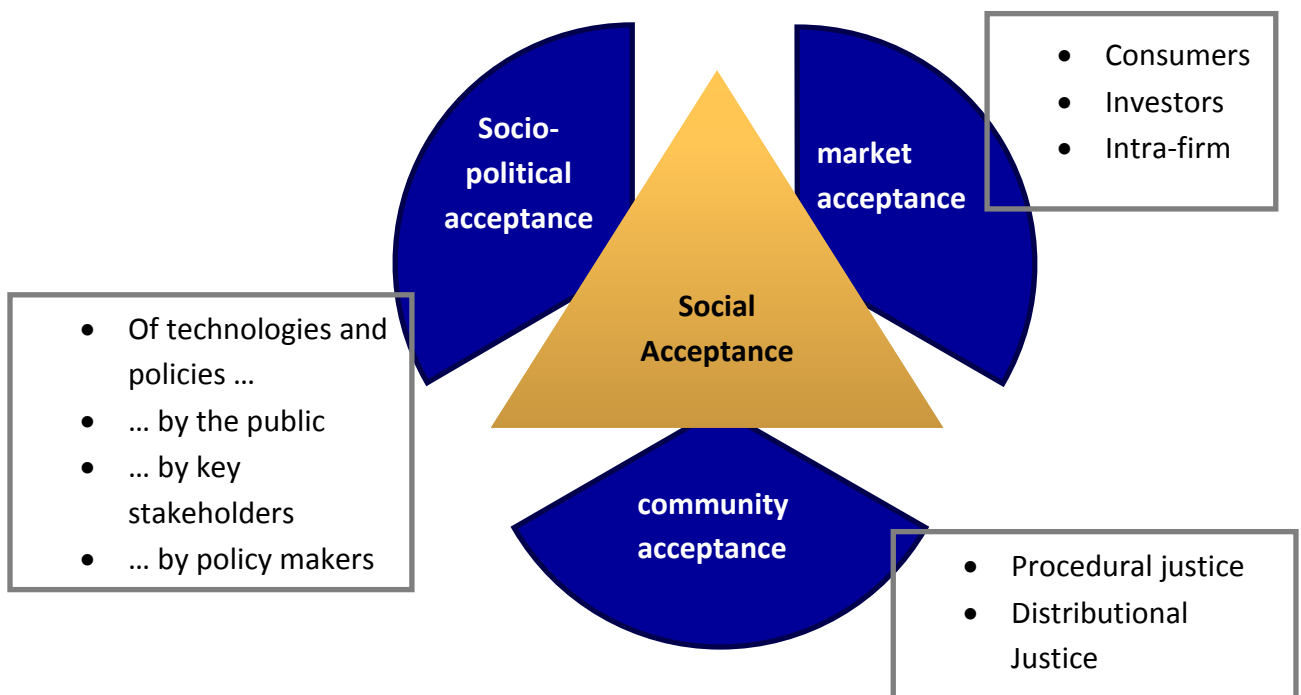


Figure 1: The triangle of social acceptance of renewable energy innovation (Wüstenhagen, Wolsink and Burer 2007)

The first category, socio-political acceptance, is the broadest and most general level. In the past, policy makers, the public and the economy anticipated, that social acceptance of renewable energies would not be a problem. The overall positive picture in surveys and polls mislead the responsible decision makers. With a growing number of actual site selections, more and more cases of social resistance on a local level were observed. As a result one has to acknowledge that social acceptance is a serious issue in implementing renewable energies. The socio-political acceptance level describes therefore a higher-level perspective

on renewable energies. This category includes the general opinion of the public and key stakeholders as well as the political framework conditions.

An application-related level of social acceptance is described by community acceptance. Community acceptance means the practical acceptance of site selections within the affected communities. Community acceptance is also the level, where the so called NIMBY-syndrome can be observed (see chapter 4.4). (Wüstenhagen, Wolsink and Bürer 2007) distinguished three factors that influence community acceptance:

- **Procedural Justice:** Fair decision process with participation possibilities for all relevant stakeholders
- **Distributional Justice:** System of sharing costs and benefits
- **Trust:** Trust of the community into investors and stakeholders from outside the community

The last acceptance level concentrates on aspects of demand and offer. Market acceptance means the acceptance of renewable power production by consumers and investors on the energy market. Intra-firm acceptance, which is a special form of market acceptance, describes the investment will of big investors (e.g. utilities), which strongly depends on their strategy and attitude towards renewable energies (Wüstenhagen, Wolsink and Bürer 2007).

A generally positive or negative attitude towards a site decision is very rare. An optimal situation for the implementation of renewable energies in a community can be described by the following points (Huber and Horbaty 2010):

- Support from expert community; local and national policy makers
- General public is informed and has a generally positive view on the technology
- For the concrete site decision there are no obstacles from local politicians, residents or NGOs
- Affected residents support the application

The attitude towards renewable energies is shaped on the one hand by deep rooted cultural and ideological identities. On the other hand it is formed by changing forms of information. As a source of information in the field of renewable energies the mass media shall not be underestimated. If one looks at the construction process of a general public opinion and at the way individuals form their decisions it becomes obvious that mass media has a strong influence on the social acceptance of renewable energies. Firstly mass media sets emphasis on certain stories and so structures the public debate with perspectives and viewpoints. And secondly the way mass media presents information influences the public perception (Heras-Saizarbitoria, Cilleruelo and Zamanillo 2011).

Social acceptance on all the three levels is not just a “nice-to-have”-factor that facilitates project development. If social acceptance cannot be reached and resistance within the public is formed this can easily be monetised. Big infrastructure projects like the rail project

Stuttgart21 often provoke protest. In the case of Stuttgart21 the costs for the different police operations until 2011 have already summed up to 15.4 Million € (Isenberg 2011). Renewable energies like geothermal power are also affected by social resistance. In Greece, for example, promising projects on the islands of Nilos and Mikos have been abandoned because of resistance from affected citizens (Olympia and Sofia 2010).

### 3. Responsible Research and Innovation

#### 3.1 An introduction to the concept

Great social, environmental and economic challenges of our time, such as climate change, ageing population and food safety, strongly demand attention by stakeholders (politicians, administrators, entrepreneurs, researchers, citizens) and require answers towards a smart society development. The European Union regards research and innovation as a key strategic factor towards smart, sustainable and inclusive growth. Science and new technologies can be turned into services and products that face societal needs and guarantee environment preservation.

As many programming documents and high level policy stated, it is the ambition of European Union to become a knowledge based society, distinguished by smart economy, high occupational rate and low environmental impact. Moreover, the Lund declaration (Svedin 2009) features the significance of addressing societal demands and ethical questions in science and technologies development. To integrate societal needs and ethical values (i.e. well-being, justice, safety, equality, sustainability, democracy, autonomy, privacy, security) in research and innovation programs and funding, stakeholder and public dialogue is strongly needed.

Responsible Research and Innovation (RRI) refers to the comprehensive approach of proceeding in research and innovation. It allows all stakeholders, involved in the processes of research and innovation, to obtain at an early stage (A) relevant knowledge on the consequences of the outcomes of their actions and on the range of options open to them. So both outcomes and options in terms of ethical values can be evaluated effectively (B) (including, but not limited to well-being, justice, equality, privacy, autonomy, safety, security, sustainability, accountability, democracy and efficiency). The last step would be (C) to use these considerations (under A and B) as functional requirements for design and development of new research, products and services (van den Hoven, et al. 2013). The reasons for not considering RRI in the present and past shall be explained in Figure 2. Scientific as well as economical motivated R&D efforts show weaknesses in terms of RRI. The reasons for insufficient R&D funding can simply be summarized as a lack of information and incentives.



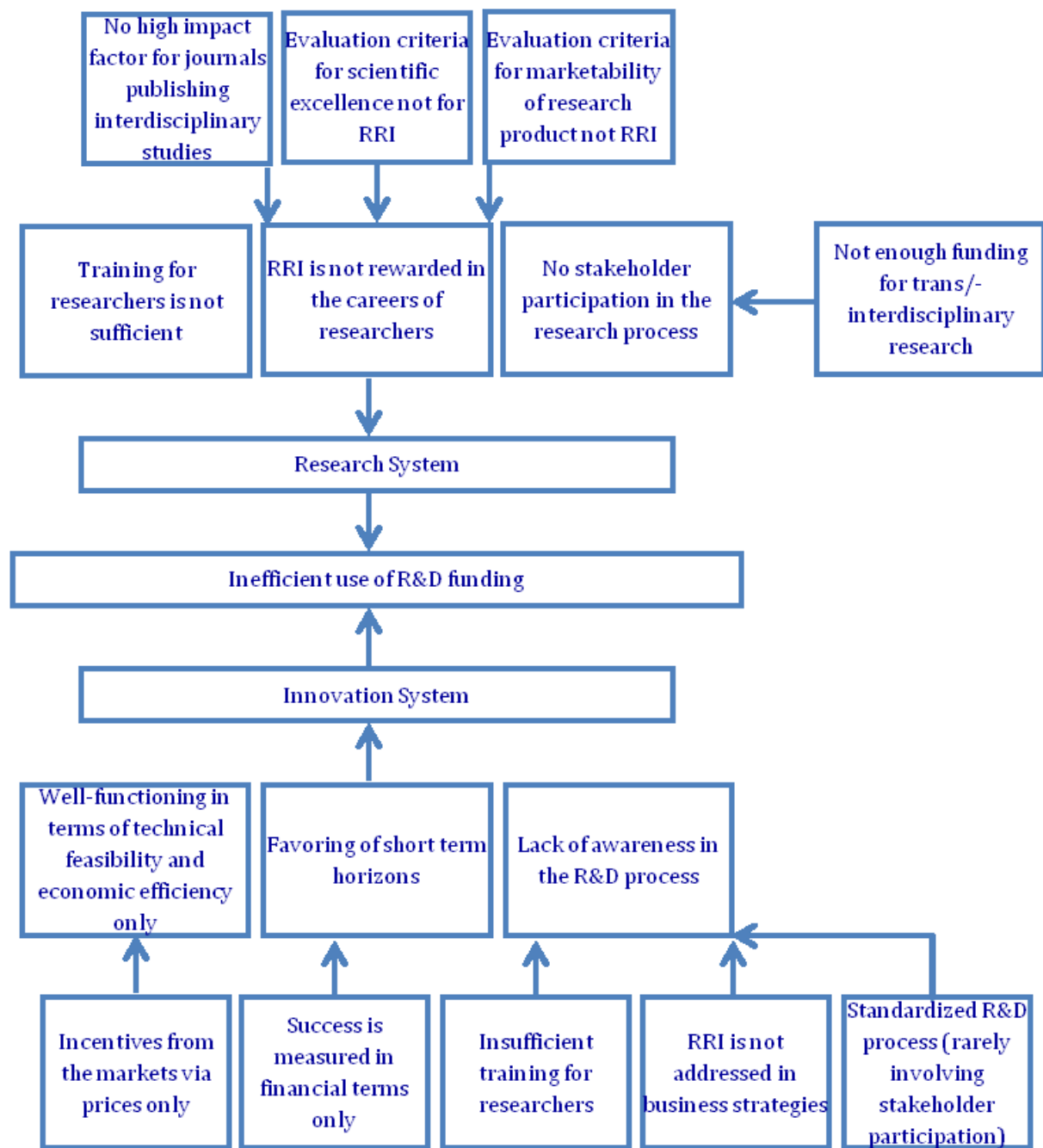


Figure 2: RRI: an overview on the underlying causes that lead to an insufficient consideration of ethical aspects and societal needs in research and innovation (van den Hoven, et al. 2013)

### 3.2 Examples of contested technologies

Many national or international research programs and innovations have been contested or have failed because they didn't take into account social needs and ethic concerns. One of the more evident examples of these innovation technologies in Europe are Genetically Modified Organisms (GMO). In the '90s the European Community has allocated 300 million euro in food biotechnologies, but the majority of European citizens do not support these technologies (Gaskell, et al. 2010). Food safety and ethical concerns related to food

patenting appear to be the major opposition causes to this genetically modified food. Especially in countries with strong food tradition (e.g. Italy) this can be observed. A consistent heterogeneity between Member States has also been registered. Despite consistent investments, social opposition to GMO has not been resolved and led to no commercialization of green biotechnologies in Europe.

The list of contested technologies in Europe is long. The grade of opposition to specific innovations can vary between Member States because of different ethical cultures. For example, stem cell research is strongly contested in countries with a strong catholic composition. Some other technologies are uniformly distrusted by Europeans citizens (Carbon Capture and Storage, nanotechnologies, electronic health records). The reasons for the lack of confidence in these technologies are different and vary from safety to privacy concerns, from the culture of precautionary principle to ethical questions related to environment and human being. Efforts in terms of investments for the development of these innovations didn't include an early consideration of ethical aspects and societal needs. Still, concerns and uncertainties, if incorporated in the design of research (and not at a late stage often just before the market introduction) can contribute to a more efficient allocation of resources.

Today, innovation systems and research priorities are mostly driven by technical feasibility and market analyses. Still, market often fails to consider ethical perspectives and to predict future societal needs and an upstream involvement of social actors is needed. For a comprehensive understanding of societal needs a constant dialogue between researchers, public institution, enterprises, regulatory bodies, associations and citizens is needed.

### **3.3 RRI and geothermal energy**

Energy issues are clearly perceived as very politicized at the moment (Pellizzone, et al. 2013). Environmental questions, land management, greenhouse gas emissions and economic impacts of energy policy make European citizens very sensitive to energy issues. However ethics is often seen as an obstacle to economic growth and the development of new technologies, but it can also operate as a driving force for innovation. In case of renewable energies (e.g. geothermal, solar and wind), the reduction of anthropic impact on environment, the creation of new jobs, the allocation of funds in research and innovation and the political question related to the energetic independence from other countries are considered as drivers for research and advance of green technologies.

Nevertheless, social acceptance of green technologies has often been underestimated. Medium to large renewable energies plants necessarily relate to land management and local communities need. Surveys conducted in European countries show that views on geothermal energy are less formed amongst citizens than views on technologies that exploit and harness solar and wind energy. So far, European citizens show little knowledge on

geothermal technologies and often different types of heat exploitation, i.e. high-low enthalpy, are not differentiated. Information on landscape impact, seismicity, gas emissions, economic and social impact of geothermal power plants are strongly required by citizens.

Ethical issues opened by geothermal technologies development could cause both positive reaction due to the exploitation of a renewable resource and negative reaction due to impacts unknown by the majority of citizens. An information campaign about this technology, its environmental, economic and social impacts is therefore strongly needed.

Surveys on citizens' expectations, concerns and needs are also essential to launch a participation program in the early stages of new plants and geothermal technology development. For a qualitative growth of research and innovation and a profitable dialogue between all stakeholders of energy policies, RRI is strongly recommended also in the geothermal project development.

## 4. Social Acceptance Issues related to Deep Geothermal Energy

Several research projects concerning social acceptance have been conducted in Germany recently. One of them, titled “Social Acceptance of Deep Geothermal Energy”, applied a media response analysis (MRA) on leading national media (LM) as well as regional media (RM) and technical journals (TM). As already mentioned in chapter 2 there is a consensus in social science, that mass media has a strong influence on the shaping of attitude towards renewable energies. So mass media like newspapers and journals can give us an overall picture of all levels of social acceptance. The above mentioned study showed that social acceptance is not a superregional, uniform topic, but has a strong regional part. It was observed that regional media have a strong impact on the local acceptance. A superregional consideration of the social acceptance issue therefore falls short of the real situation on site (Leucht 2011).

Figure 3 presents positive acceptance factors that have been revealed in the different media. RM shows a clear gradation in the frequency of usage. “Renewable energy” and “base load capacity” are the most frequently used positive key words in such media. TJ on the other hand show a uniform distribution over the different acceptance issues, while LM appears to have a certain accumulation of acceptance issues but no clear structure.

Figure 4 compares negative acceptance factors in print media. It is quite obvious that the quantitative number of single acceptance factors such as damage of private/public property in RM is much higher than for positive acceptance issues.

For further considerations in this report we want to focus on issues that have the potential to cause social resistance. These issues are normally negative, which leads to a further investigation of negative acceptance issues. Therefore four categories have been identified:

- Environmental issues
- “Missing-involvement” issues
- Financial issues
- NIMBY issues

and are investigated more closely in the following chapters.

## Reference of positive acceptance factors in the print media discourse in 2010 - 2011

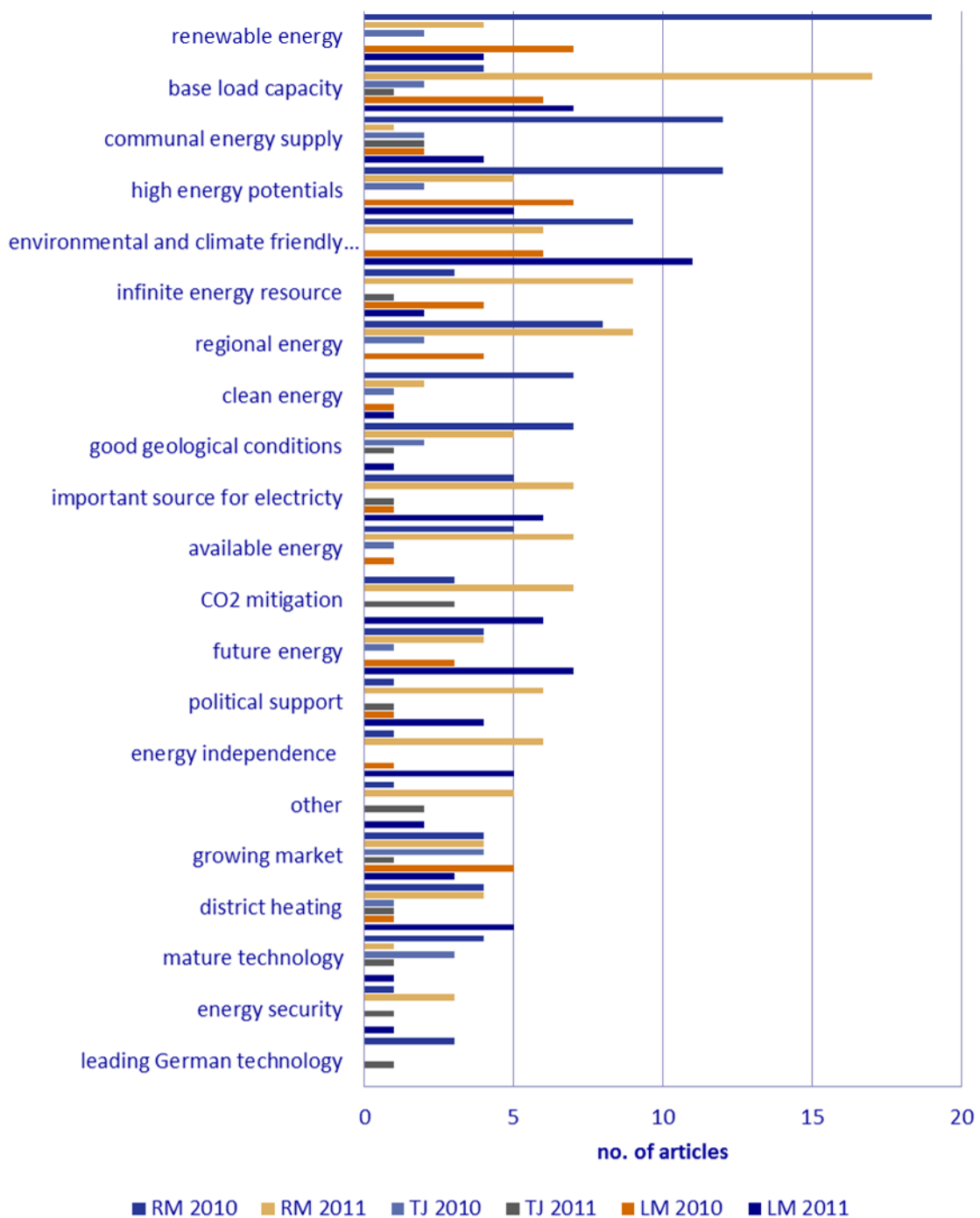


Figure 3: Positive acceptance factors in print media Taken from (Leucht 2011)

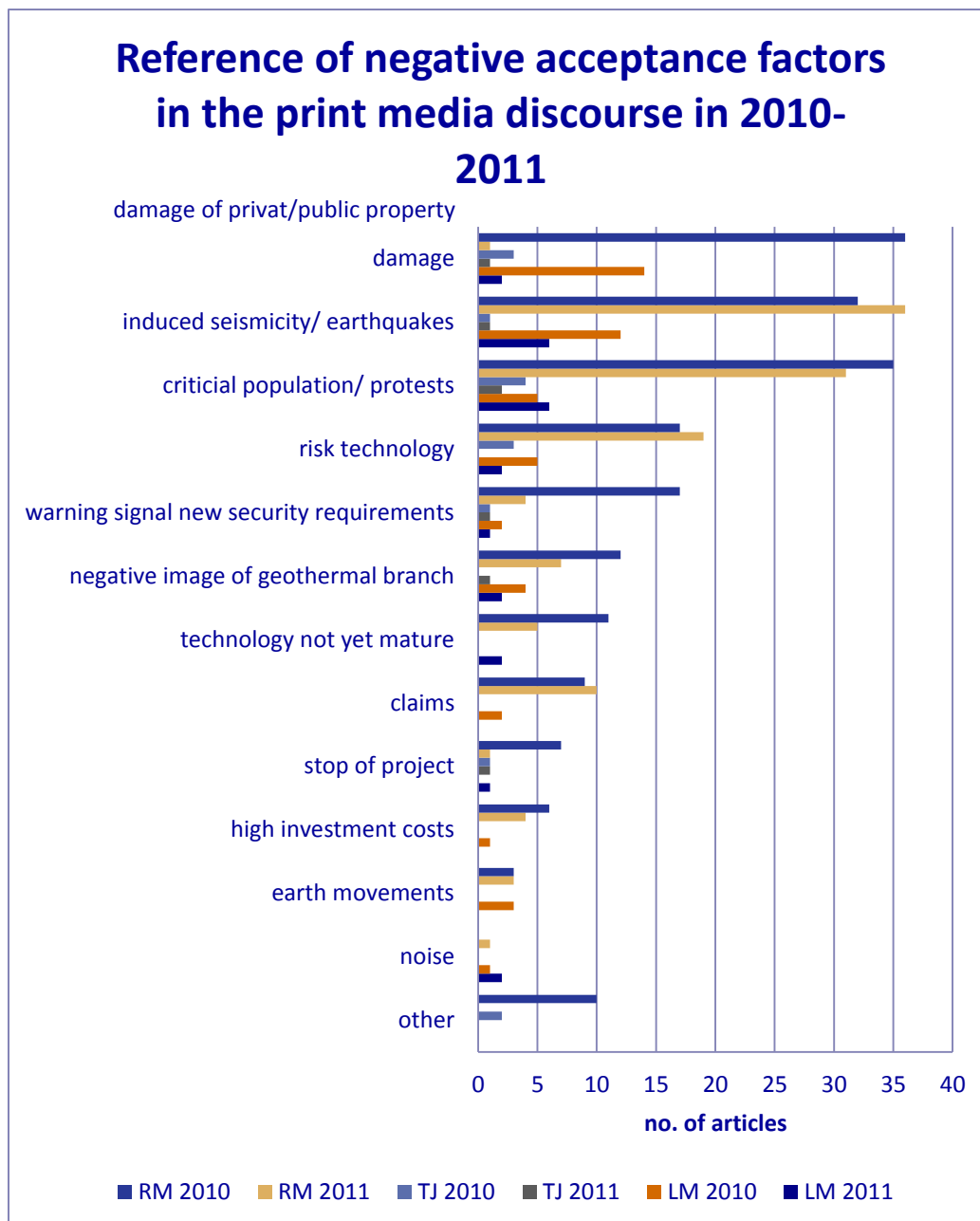


Figure 4: Negative acceptance factors in print media (Leucht 2011)

## 4.1 Environmental issues

Article 2a of the European directive 2009/28/EC for the promotion of the use of energy from renewable sources defines geothermal energy as a renewable form of energy. Further development of renewable energies is secured by a broad social consensus. This can for example be seen in a poll of the German renewable energy agency. 93 % of the German population considers the enforced development of renewable energies as important or very important (Agentur für Erneuerbar Energien, n.d.). Renewable energies are often associated with sustainability or environmental friendliness. But renewable energies also have

environmental impacts. Therefore it shall be referenced to the GEOELEC-study on environmental issues of geothermal energy (WP 4.2). In the following, social acceptance issues with an environmental background are discussed. The selection of environmental issues is based on (Leucht 2011) (Hagedoorn 2006) (Mannvit 2013) and (Oduor 2010).

Greenhouse gas emissions:

During the production of geothermal brine one does not only get a fluid phase at the surface but a mixture of fluids and gas. The composition of geothermal brine can differ significantly from site to site. The geothermal power plant in Bruchsal (Germany) for example has under norm conditions in a norm cubic meter a fluid/gas ratio of 2:1. Around 90 % of the gas phase consists of CO<sub>2</sub> (Mergner, et al. 2012).

There are three main types of geothermal power plants. Binary power plants (like the geothermal power plant in Bruchsal) usually work in a closed loop system, where the produced brine is re-injected after usage in the power plant with all its ingredients. However in dry steam and flash power plants noncondensable gases like CO<sub>2</sub> and H<sub>2</sub>S are separated in the condenser of the power plant. These gases are either released to the atmosphere or treated in an abatement system, while the fluid parts of the brine are usually injected into the ground (Holm, Jennejohn and Blodgett 2012)

Compared to fossil fuel power production technologies, geothermal power systems emit only a small amount of greenhouse gases. Table 1 compares several power production systems on the basis of their emissions.

As already mentioned, greenhouse gas emission of geothermal power plants are strongly influenced by the power plant type and the natural conditions in the reservoir. If one takes CO<sub>2</sub> as a benchmark, then Geothermal closed-loop-binary plants emit 0 CO<sub>2</sub>.

Although geothermal power plants emit considerably less greenhouse gases than fossil power plants, the fact that a renewable power plant may not be greenhouse gas neutral in its production process could cause social resistance.

**Table 1: Emissions of geothermal power plants during production (Mannvit 2013) (Massachusetts Institute of Technology 2006)**

Plant type	CO <sub>2</sub> [kg/MWh]	SO <sub>2</sub> <sup>1</sup> [kg/MWh]	NO <sub>x</sub> [kg/MWh]	Particulates [kg/MWh]
Coal-fired	994	4.71	1.955	1.012
Oil-fired	758	5.44	1.814	N.A
Gas-fired	550	0.0998	1.343	0.0635
Geothermal-flash-steam, liquid dominated-USA	27.2	0.1588	0	0
Geothermal-The Geysers dry steam field-USA	40.3	0.000098	0.000458	negligible
Geothermal-closed-loop binary	0	0	0	negligible
Geothermal-flash steam-Hellisheidi-Iceland	21.6	17.6*	0	0
Average. All European power plants (renewable & fossil)	369.7	1.1	0.5	0.1

### Seismicity:

Seismicity and damage through seismicity has been detected as one of the major negative acceptance factors for geothermal power in Germany (Leucht 2011).

Seismicity is induced through the reinjection of water/brine under relative high pressure into the subsurface. Through changing the pore pressure one affects the local stress field (Rybach 2003). Although most seismic events are not within the human perception threshold of magnitude 2-3 (i.e. only measurable and cannot be noticed physically), people are very afraid of possible damages through seismicity induced by geothermal power plants. One well known example for effects of seismicity on geothermal projects is the EGS (Enhanced Geothermal Systems) project in Basel (Switzerland). In Basel several seismic events with magnitudes up to 3.4 were felt by the local population. There were a number of approximately 2500 requests for financial compensation of damages with a value of approximately 7 million CHF. Forced by the fact that the average of each damage was at around 500 CHF and further investigations would be more expensive than the total sum requested, the project company decided to pay without any further examination. Following the seismic events the project was abandoned (City of Basel 2010)

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<sup>1</sup> Assuming 100 % conversion from H<sub>2</sub>S to SO<sub>2</sub>



As mentioned, seismicity is caused by the injection of water under high pressure. Through a seismic monitoring and a controlled injection of water into the subsurface, seismic events can be controlled. As an example for the handling of social resistance in context with seismicity one could take the mediation process in Rhineland-Palatinate (Germany), where different stakeholders agreed on guidelines for the operation of geothermal power plants. These guidelines specify the actions that have to be taken for measurable seismic conditions by power plant operators (Team Ewen 2012). Parallel the U.S. Department for Energy has developed the “Protocol for Addressing Induced Seismicity Associated with Enhanced Geothermal Systems” (Majer, et al. 2012). This protocol gives project developers in the field of EGS-power plants a guideline for handling the possible risk of seismicity within their project. A special focus is kept on dealing with stakeholders from public and authorities. But also within research new concepts for handling seismicity within geothermal projects have been developed. The GEISER project for example investigated the possibility to anticipate the effects of induced seismicity within a geological formation. The project developed models to calculate parameters of seismic events and translate them into a traffic light system. This traffic light system is a practical solution for project developers and other stakeholders to handle the risk of seismic events during stimulation (Wiemer 2013).

**Subsidence:**

Subsidence might take place, when the fluid withdrawal through geothermal power plants exceeds the natural or artificial (reinjection) inflow into the reservoir. The fluid withdrawal reduces the pore pressure in the rock formation, which finally leads to subsidence (Hole, et al. 2007) (Shibaki and Beck 2003).

This effect can be observed in high enthalpy fields all over the world. In the Wairakei geothermal field in New Zealand a total subsidence of 15 m was recorded. So on average a subsidence of 400 mm/year has occurred, but this can be seen as an extreme case. In Svartsengi, Iceland one can monitor a subsidence of 10 mm/year, whereas in Lardarello, Italy the earth moves 250 mm/year (Hole, et al. 2007).

**Noise:**

As long as a combined heat and power generation through geothermal power is planned, it is advised to build geothermal power plants as closely as possible to customers to shorten the length of heat transport pipelines and thus minimise the associated heat losses. But even without a direct heat usage, geothermal power plants in highly populated regions such as Central Europe are often close to settlements and in this way cause noise emissions. As (Leucht 2011) showed noise levels are a serious social acceptance issue for affected citizens.

During the deployment phase of a geothermal project the highest noise levels can be expected. Drilling and construction phase go along with noise levels from 45 – 120 dBa

(Shibaki and Beck 2003). The production of geothermal power itself causes a noise level of 55 – 70 dBa (Hagedoorn 2006).

Through sound insulation, a strategic positioning of the whole power plant (close to an already existing noise emitter) or of single components, the total noise level of the power plant can be reduced. This is however rather a cost-issue than technical feasibility. So in this case, the valid law and the relationship to the residents set the framework. In Germany for example the law regulates the noise level depending on the area and the daytime.

Taking the example of the geothermal power plant in Bruchsal (Germany), the power plant building is situated between the cooling tower (highest noise emitter) and the residential buildings (bottom, right side). So the power plant building shields the residential buildings from noise emissions (See Figure 5).



Figure 5: Binary power plant in Bruchsal, Germany

### Visible surface changes:

During the construction phase the strongest visual impact can be expected through the drilling platform, surrounding equipment, streets, traffic and power lines (Mannvit 2013). These impacts are only of limited duration. But as (Leucht 2011) discovered, earth movement and the visual impact through buildings is a social acceptance issue.

To limit the visual impact of buildings they can be “landscaped” to fit into the characteristics of the countryside (Hagedoorn 2006). Scientific sources differ in the exact amount of required land for geothermal power plants. But it can be stated that compared to other power production facilities, the land requirement of geothermal power plants is small as shown in Table 2.

Table 2: Land requirement for power generation (Afgan and Carvalho 2002) (Shibaki and Beck 2003)

Technology	km <sup>2</sup> /kW (Afgan and Carvalho 2002)	m <sup>2</sup> /GWh/yr (occupied) (Hagedoorn 2006)	km <sup>2</sup> /MW (Shibaki and Beck 2003)
Solar thermal	0,08	3561	
Photovoltaic	0,12	3237	
Wind	0,79	1335	
Biomass	5,2		
Hydropower	0,13		
Geothermal power	0,03	404	0,004 -0,032
Nuclear	0,01		0,02 – 0,041
Coal	0,4		0,077
Gas	0,04		

#### Other environmental issues:

Besides the environmental issues which have been named by (Leucht 2011) as negative influence factors on social acceptance, other environmental issues also have the possibility to become a social acceptance issue. The GEOELEC-project published an environmental report (Mannvit 2013) that goes further into detail. With a growing environmental awareness, other environmental issues could come into the focus of the public.

#### 4.2 “Missing involvement”-issues

In the course of the transformation of the energy system, a growing number of power plants based on renewable energies will have to be built. Since these power plants often have smaller capacities than conventional power plants, more power plants will be needed. Additionally these power plants will be/are situated in locations where power production was not common, yet. The so called turnaround in energy policy therefore requires a high adaption effort of the citizens. Citizens and communal decision makers have to make decisions under time pressure and with only limited or no information on long term consequences of their decisions for or against renewable energies. Decisions under insecurity can lead to emotional reactions, when citizens feel overstrained and overrun. Therefore (Leucht 2012), (Cataldi 2001) and (Devine-Wright 2007) recommend an involvement of local citizens into project planning and implementation.

(Leucht 2012) distinguishes concerning the implementation of affected residents two approaches:

1. Acceptance as a goal of the project realization
2. Acceptance as an indicator in the process of project development

For approach 1 central technical details like (timeframe, location, power cycle) are already determined. As a communication strategy persuasion is the only possibility. Leucht recommends communicating this situation. A participation offer with no influence on the outcome would only lead to mistrust and aversion towards the project developers.

Approach 2 doesn't have a fixed outcome. The goal is to start an open communication process, which delivers details for the site decision. The communication strategy in this case would be to negotiate about projects' details. At the end of the process stands an accepted solution for all relevant stakeholders. A challenge for the project developer is the decision on appropriate participation possibilities and the implementation of all relevant stakeholders (Leucht 2012).

Both approaches show the ends of a bandwidth. For approach 1 a higher acceptance could be reached if decisions on parts of the project could be taken in a cooperative process. In case of a geothermal project this could be the time frame for certain construction steps or the integration of buildings into the landscape. On the other side a predefined solution could also reach a high level of acceptance, if it already integrates main requirements of the local community. Approach 2 bears the challenge of setting appropriate side conditions. Although the discussion should be open in terms of its results, clear frame conditions are necessary to guide the discussion. The project developer therefore has to plan with appropriate time frames and the possibility of negative results. To enable a successful project development Leucht therefore recommends a professional project communication, appropriate time frames for communication and a budget for this part of project development (Leucht 2012).

### **4.3 Financial issue**

One of the results of (Leucht 2011) was that people could see investment costs of geothermal power plants as a negative social acceptance issue. In Germany municipalities or municipal undertakings are often involved in geothermal projects.

Figure 6 shows the results of a multinational study that analysed the financial situation of renewable energies in the European energy market. The figure shows that between the different renewable energy technologies there are big differences in investment costs and this makes a general statement very difficult. It can be seen that under good conditions geothermal power in Europe is competitive to other renewable energy sources. On the other side the wide range in investment costs of geothermal energies needs a case specific consideration of every single project.

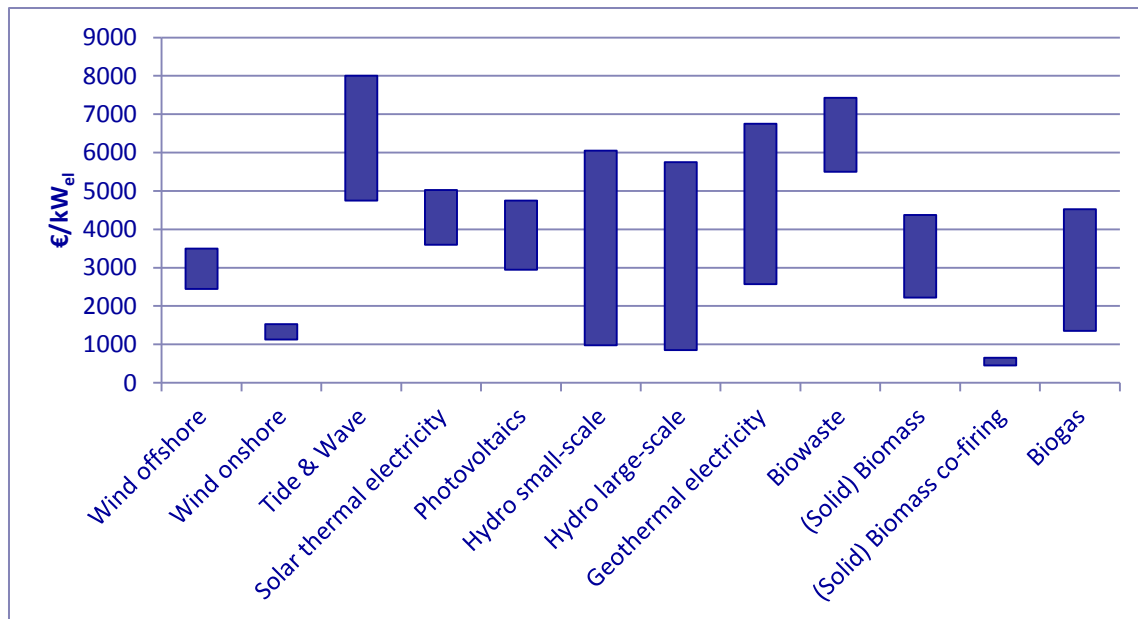


Figure 6: Investment costs of renewable energy sources for the European energy market [€/kW<sub>el</sub>] (de Jager, et al. 2011)

If one additionally considers the levelized costs of energy (LCOE) [€/MWh] a general statement for the most cost effective renewable energy technology is not possible. Figure 7 shows the LCOE for renewable energy technologies in Europe. Similar to the investment costs one can observe a wide range of energy costs. But the study of (de Jager, et al. 2011) shows that geothermal electricity is competitive to other more developed renewable energy technologies such as hydro-power plants.

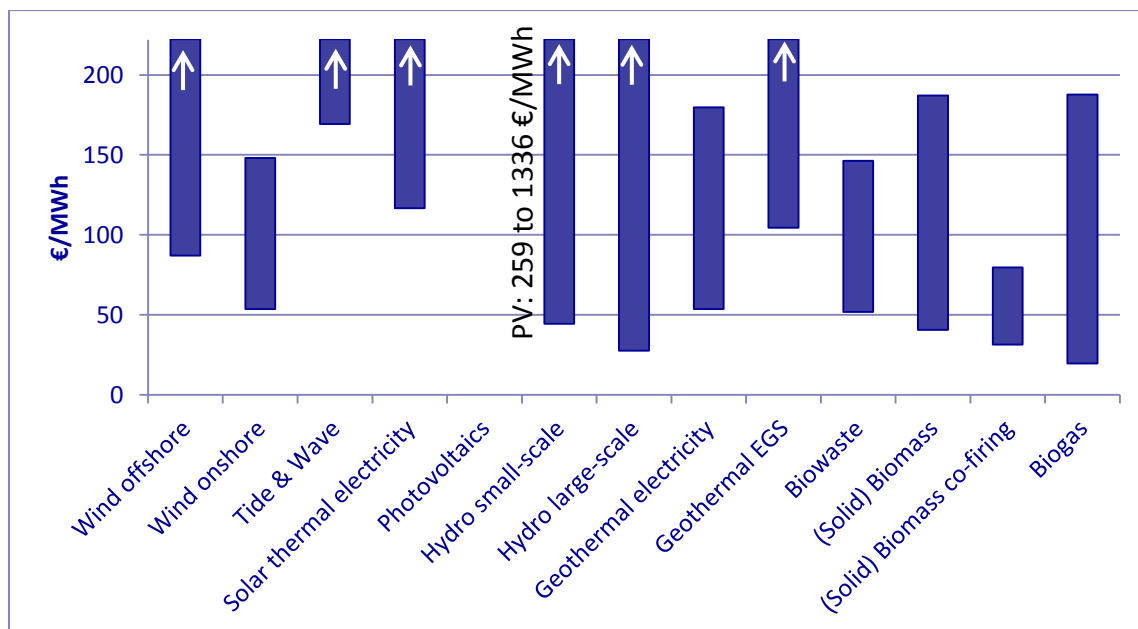


Figure 7: Levelized costs of electricity renewable energy sources in Europe [€/MWh] (de Jager, et al. 2011) (Mines und Nathwani 2013)

Besides investment costs and LCOE, national support schemes have a great impact on the profitability of renewable energy projects. In conclusion one has to consider each project

separately. A general statement for the profitability of a renewable energy project wouldn't be valid.

#### 4.4 NIMBY-issue

The Not-in-my-backyard-issue (NIMBY) can be defined as follows:

“The NIMBY syndrome, which arises with any effort to site locally undesirable but socially beneficial facilities” (Richman and Boerner 2006)

So the NIMBY-syndrome describes local resistance against socially beneficial facilities. This could be a homeless shelter, an incineration plant, an airport or facilities for energy production and distribution.

In the course of the German energy turnaround, surveys show the paradox situation that a majority (93%) of the respondents supports the enforced development of renewable energies, but the acceptance declines, when a renewable power plant is located close to their homestead (see Figure 8) (Agentur für Erneuerbar Energien, n.d.).

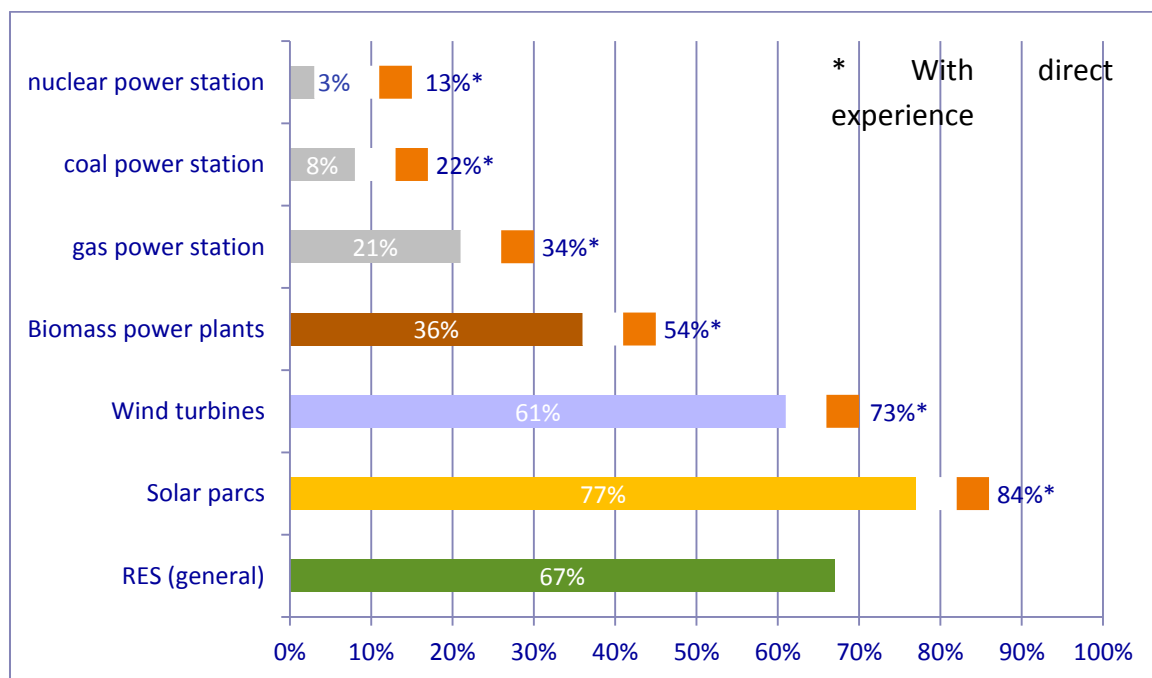


Figure 8: Agreement with RES in direct neighbourhood (Agentur für Erneuerbar Energien kein Datum)

A similar public opinion can be found in other developed countries such as Australia (Dowd, et al. 2006). In general, it appears that citizens prefer RES-technologies that are far away from their neighbourhood and rather belong to a centralized energy system with big production capacities at one point (Scheer, Wassermann and Scheel 2012).

The NIMBY-issue is sometimes described as unreasonable. It is stated that the public is not willing to take any risk in favour of the society. This risk adversity can be explained by a lack of information (Olympia and Sofia 2010). But often project developers and responsible

(public) authorities underestimate the interest and the knowledge of persons and groups concerning RES and the energy business (Hauff, et al. 2011).

Usually the NIMBY-syndrome has its roots right at the beginning of a project, when project developers do not consider the local society, their fears and needs. People see those projects as imposed from people in higher position and without local roots. They are usually a priori against the project developers and not against the project itself (Olympia and Sofia 2010).

A solution could be to change the classical triangle of energy generation. Traditionally energy generation moves within the triangle of profitability, supply security and environmental compatibility (see left side Figure 9). To integrate an informed and interested society, one should integrate social acceptance into energy politics. Therefore a change of mind in the energy business is needed. The traditional triangle has to be adapted to the changing society. The triangle becomes a square, which symbolizes the social acceptance as an additional fourth goal of energy business (Hauff, et al. 2011).

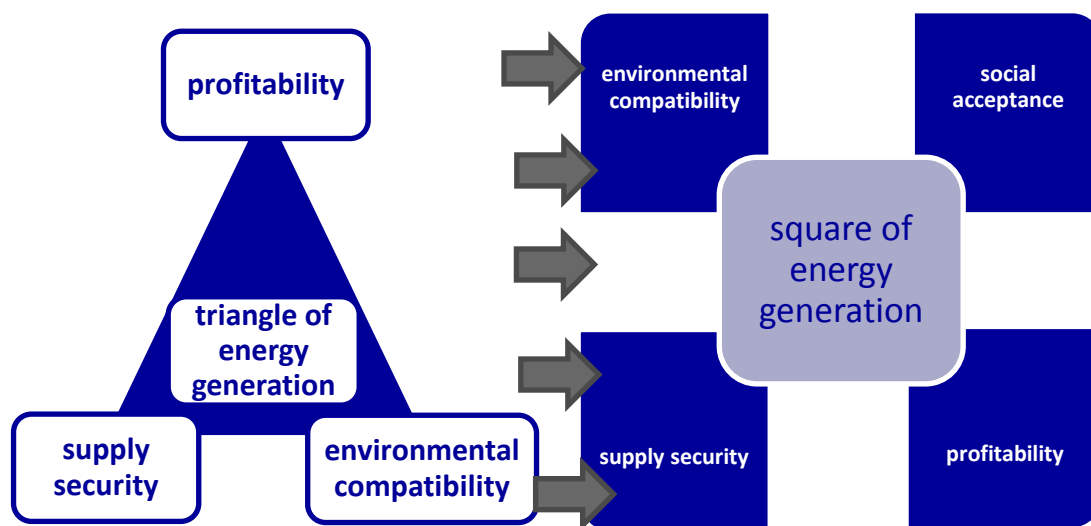


Figure 9: Square/ Triangle of energy generation (Hauff, et al. 2011)

The integration of the public and thus social acceptance can be reached through three steps (Hauff, et al. 2011):

- Communication and information:

Affected citizens have to be informed openly and in advance about costs, risks and benefits of a technology.

- Integration and involvement

Additionally one could think about models of direct financial participation in a project or other local benefits like heat supply in case of geothermal power plants.

- Balance of interests and conflict resolution

If conflicts occur, the project developer should try to find a dialogue without predefined results.

## 5. Practical Examples for social acceptance

In the following practical examples from Italy, Germany and France are presented. The different studies give an overview over the local situation concerning public acceptance of the different geothermal projects or regions. The case studies show anxieties and worries of affected citizens. This can be a valuable support for project developers. If one addresses these anxieties and worries proactively, then their influence on the project development can be reduced.

### 5.1 Case study Italy

The research project “Vigor” – a project led by the Italian National Research Council (CNR) and the Italian Ministry of Economic Development (MiSE) explore the potential of exploiting geothermal energy in southern Italy. The study includes a detailed case study on social and community acceptance in the area of Termini Imerese, province of Palermo (Sicily). The aim of the case study was to capture and analyze the views of citizens and other stakeholders.

MiSE, CNR, and the Region Sicily selected for the case study the area of Termini Imerese in the province of Palermo, Sicily. There hydrothermal circulation is present through the occurrence of two well-known hot springs.

The recent innovation agenda of the European Commission sees societal dialogue and public consultation in early phases of technology development (so called upstream engagement) as pivotal to the successful implementation of innovation policies. This case study is a step, towards early public engagement in the development of technologies that impact the daily life of citizens.

In Europe societal dialogue seems to be pivotal to successful implementation of innovation policies (van der Hoven et al, 2013, Von Schomberg, 2013). The area of Termini Imerese therefore was selected as case study towards designing approaches for “upstream” public engagement in the technology developments.

In the area of Termini Imerese stakeholders (citizens, political parties ...) were particularly sensitive regarding innovation and energy policies. The impending regional elections and the prospect of local employment crises due to the closing of the Fiat industrial plant made the local situation very complex.

To explore the views and social attitudes towards technologies harnessing geothermal resources, we used both qualitative (1) and quantitative (2) approaches:



- 1) Focus Groups were conducted out of four different groups (students, stakeholders, citizens of Termini Imerese, unemployed Fiat workers). All the discussions were recorded, fully transcribed and analyzed using specialized software for text analysis.
- 2) A telephone based survey with a sample of 400 citizens calibrated by gender, age, education, job condition and residence was carried out in the province of Palermo.

#### **5.1.1 Public views and attitudes towards geothermal energy**

Compared to other renewable energies (e.g. solar and wind), the views of Sicilian citizens on geothermal energy usage appear much less formed. When asked if technologies would impact our way of life in the next 20 years, 54% of the respondents answered that solar power would have a positive impact. 46% thought the same of wind power, while geothermal energy, was only mentioned by 17.5% (Figure 10). The percentage of uncertain answers (“I don’t know”) to this question is particularly high for geothermal energy (42%). These findings are striking and somewhat similar to the response patterns when respondents were asked about biotechnology and not so different from views on nanotechnology. Biotechnology and nanotechnology are new, often unfamiliar and even contested technologies while geothermal power has been present in the Sicilian landscape, as long as the inhabitants. The study also showed that the strong aversion to nuclear power clearly remains deeply rooted.

The exploitation of geothermal energy was mostly discussed favorably within the four focus groups. The discussion was not started with a concrete plan for the exploitation of geothermal power in Termini Imerese. To facilitate the discussion stimulus material (basic information on geothermal energy), was provided by the VIGOR project. Participants clearly see geothermal power with optimism and a certain degree of confidence. Geothermal energy exploitation is also associated with potentially positive effects on employment, environment, technology innovation, reduction of energy costs and independence from energy imports. Independence from energy imports and the usage of local sources of energy was a reoccurring issue in all the focus groups.

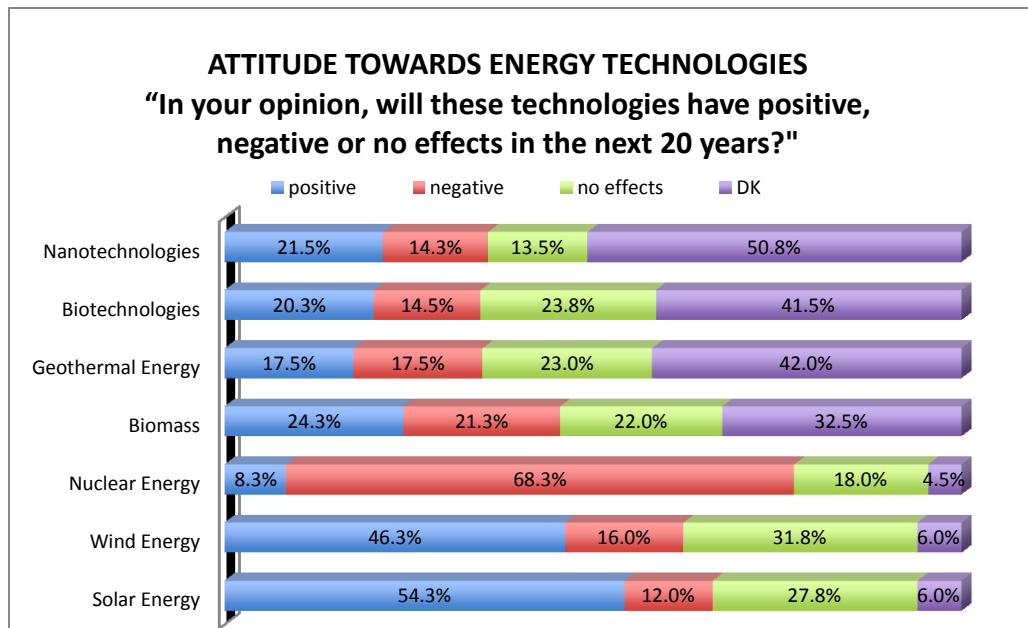


Figure 10: Attitude towards energy technologies

Discussions within the Focus groups also revealed that geothermal energy is mostly seen as a great opportunity for the future development of Sicily. Geothermal power is generally positively associated with renewable energies: reduction of emissions, autonomy from fossil fuels and a turnaround in energy production.

The literature on social acceptability of geothermal energy is currently still somewhat scarce. However recent studies conducted in Australia show that the major concerns about geothermics are environmental issues like water usage, seismic activity, and gas emissions (Dowd, 2010). In this case-study, all these issues came up during the discussion but seem to be secondary compared to economic, political, cultural and bureaucratic matters. This underlines the importance of local economics, social and political factors in the evaluation of technologies for energy provision. The exploitation of geothermal energy is perceived as an important opportunity for the industrial area of Termini Imerese.

"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)

Compared to the gas power plant today active in the region, geothermal energy is mostly seen as a step towards sustainable development. Surprisingly interviewed university students show some resistance and reluctance to this kind of energy production. Additionally they are much more vocal than the other three groups in demanding more information about the benefits and risks of the exploitation of geothermal energy. In contrast, the group of local automobile industry workers who are currently unemployed, were the group most supportive for the idea of developing local geothermal resources

### 5.1.2 Geothermal energy exploitation, politics and bureaucracy

Respondents identified politics and bureaucracy as major constraints to the development of geothermal energy. Because of the upfront costs of geothermal energy exploitation, citizens see public financial support as necessary for a development of geothermal technology. On the other side economic investments are perceived as intricately connected with corruption, speculation, mismanagement and criminality.

At the moment, investments and energy politics of the region are perceived as highly politicized. Major concerns rise from a lack of confidence towards politicians, energy companies and federal institutions in general. Respondents mistrust the responsible persons in adequately and ethically managing innovation processes. As evidence of mismanagement and possible mafia intrusion in the energy sector wind farms were mentioned:

“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)

“We are badly administrated”. (Citizens focus group)

“We lack a culture of common goods”. (Fiat workers focus group)

“Bureaucracy is too slow”. (Fiat workers focus group)

“We have two kinds of problems: one is bureaucratic and the other one is political”. (Stakeholder focus group)

“There are too many interests of political and Mafioso order”. (Citizens focus group)

“Politicians depend on fossil fuel taxes”. (Citizens focus group)

The general thought is that any kind of investment on the Sicilian land needs to be beneficial and bring concrete gains and benefits for the local population:

“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”. (Student focus group)

The Sicilian identity of the participants in the focus groups was highly salient. Greater involvement of citizens in land management and energy policy was demanded. Additionally social and economic advantages for the Sicilian people are cited as fundamental prerequisites for geothermal exploitation on regional land.

Economic interests of stakeholders (politicians and energy companies) are often perceived as in contrast to interests of Sicilian citizens, which strongly ask for more consideration of the “public good”.

### 5.1.3 Geothermal energy and public information

Both focus groups and questionnaire results show an almost general lack of information about geothermal energy and its implication on environment and society. Respondents feel less informed about geothermal technologies compared to other renewable energies. Particularly, the questionnaires showed that only 17% of the participants have heard about geothermal energy and different types of heat exploitation, i.e. high-low enthalpy are not differentiated.

“We need more information. What we know, is mostly from company’s advertisement”. (Stakeholder groups)

“To discuss this subject, we need more information. We are not experts and we don’t know a lot about the impacts of geothermal power plants”. (Students focus group)

When asked about the subject of geothermal energy exploitation, respondents would like to be more informed. Questionnaire respondents converged their attention on economic impacts on local population, electricity grid and plant management, as can be seen in Figure 11.

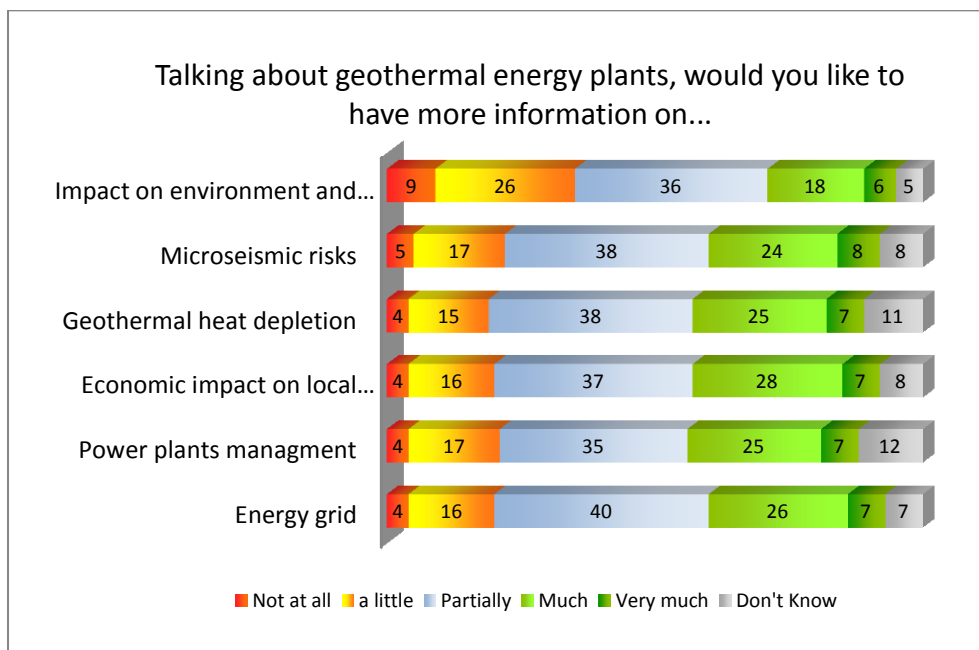


Figure 11: Information demand on geothermal power plants

The results from the focus group indicated that participants did not feel competent enough to evaluate or make up their mind about the opportunities and potential of geothermal power. They require more information and communication in order to be able to fully participate in the discussion.

Survey respondents were also asked about the reliability of information sources. The results in Figure 11 show highest level of confidence in researchers and Universities, while local administrations and politics in general are considered least trustworthy.

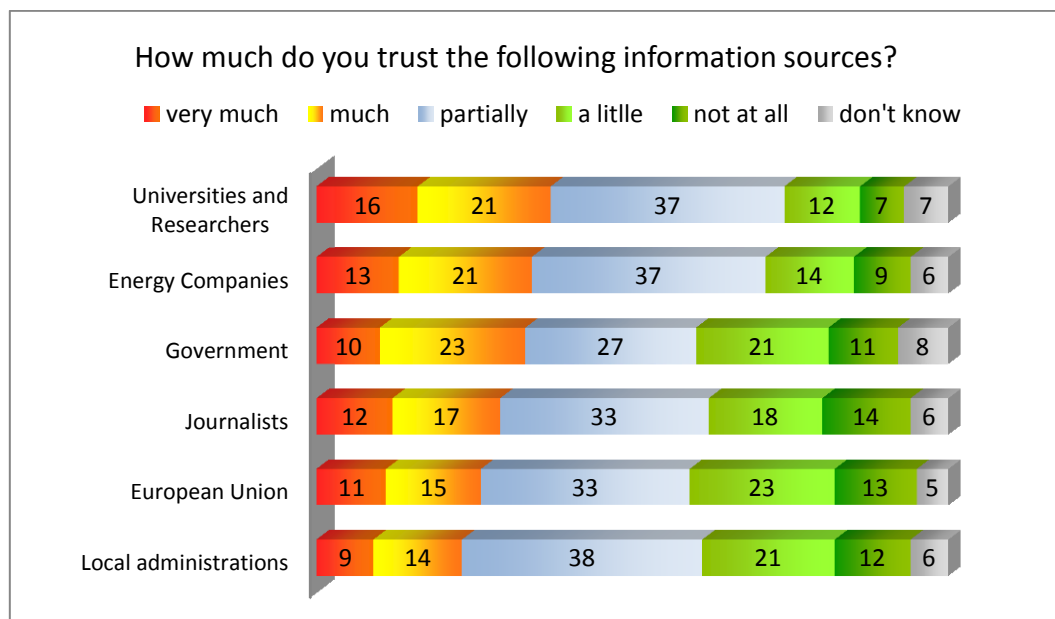


Figure 12: Trustworthiness of information sources

#### 5.1.4 Conclusions

The results from this case study, carried out in collaboration with citizens and other stakeholders from Palermo Province, indicate considerable openness and interest for geothermal heat exploitation. However, the low level of knowledge on the subject, uncertainty and the strong lack of confidence towards the political class highlight the need for substantially improved communication and information campaigns. In order to reduce uncertainties and to stimulate public participation on a socially and culturally sustainable path more communication is needed. Opinions on geothermal power are compared to other RES much less formed. These findings further reinforce the importance of reliable public communication efforts through research institution, energy companies and public institutions.

More effective communication forms the very basis of societal dialogue over generally sustainable innovations in the energy sectors as well as in other fields. The Horizon 2020 strategies regard communication and dialogue between citizens and stakeholders as essential when planning investments related to the development of new technologies and land management.

In the study no concrete and already formulated plan for the exploitation of geothermal power in Termini Imerese was put forward. The object of the discussion was rather the

effort that is termed “upstream engagement of citizens” where the view of citizens and stakeholders are sought at the very beginning of the process of technological development.

## 5.2 Case study Germany

In the research project “Evaluation of public relations of geothermal projects in Germany and development of a practical support for developers and operators of geothermal power plants”, four geothermal projects in Germany have been evaluated. For this purpose, a media response analysis (MRA) and a stakeholder analysis (SA) have been conducted in the research project. The four projects are located in Bruchsal, Brühl, Landau and Unterhaching. All these sites are characterized by local frameworks conditions. Additionally, they differ in progress, installed capacity and social acceptance.

### Bruchsal:

The geothermal power plant in Bruchsal has a long history. In 1979, first investigations for a local heating network started. After the completion of two boreholes, the project was abandoned because of missing profitability. In 2006, EnBW (utility company) started to engage in the project. Since 2009 a 550 kW power plant is in operation and since 2012 the project is headed by EnBW. The power plant is entitled by EnBW as a research power plant.

The characterisation as a research power plant mainly determines the social acceptance situation in Bruchsal. The stakeholder analysis has shown that there have not been many public relation actions in the past. The power plant is quite small and situated in an industrial area, which together with no accidents, no seismicity or other disturbances have caused a situation of “invisibility” for the public (Wallquist and Holenstein 2012).

The MRA brought similar results. Figure 13 shows a rather positive press response for the geothermal power plant in Bruchsal, whereas compared to other power plants only very few articles have been written.

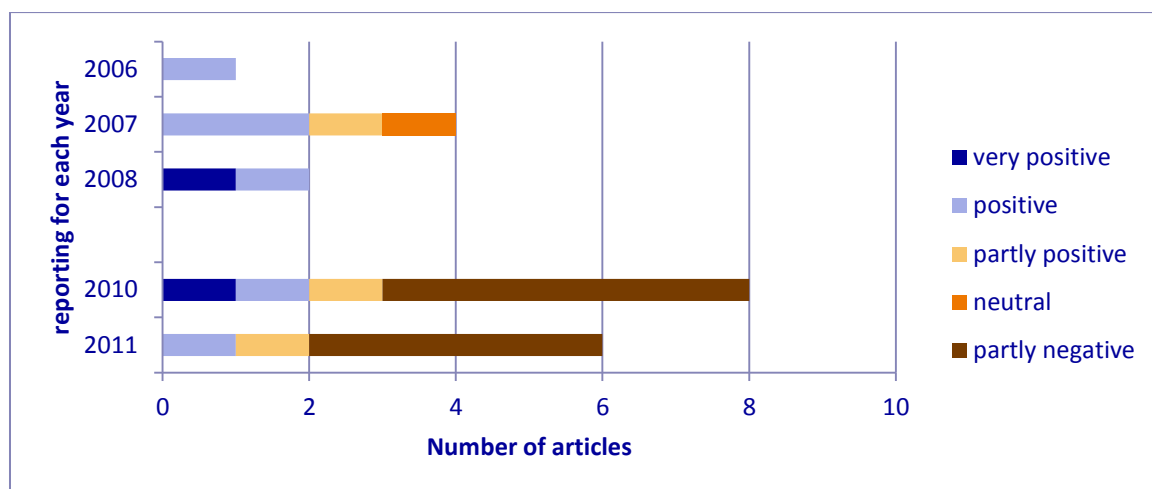


Figure 13: Reporting on the geothermal power plant in Bruchsal (Leucht 2012)

In the MRA it also becomes obvious that only little public relation activities have been done by the operators. The press sees Bruchsal as a small scale research project that does not cause much risk for the public. It is sometimes used as an example for the potential of geothermal power production or in context with seismicity in other project locations. The project itself currently does not give “any critical connection point for the public that needs communication” (Leucht 2012).

### Brühl:

The geothermal power project in Brühl is currently in the construction phase. At the beginning of February 2013 the first borehole was completed. In the final phase the geothermal power plant shall produce electricity with a capacity of 5-6 MW<sub>el</sub> (GeoEnergy GmbH 2013).

The SA found that the population has a strong mistrust towards the project and the project developer. In 2008, when the contracts between municipalities and project developer were signed, the public opinion was positive. But after the seismicity caused by the geothermal power plant in Landau the public opinion changed and currently there is a strong opposition with a well-connected citizens’ initiative. Brühl is deeply divided because of the geothermal power project. People are scared because of the project. The public relation efforts of the project developer did not reach the public. Meanwhile public relations efforts are rather seen as propaganda (Wallquist and Holenstein 2012).

In the geothermal project of Brühl, the MRA and the SA draw a similar picture. As already stated in the SA, the project has strong acceptance problems. This can also be seen in the MRA with a negative impression out of the investigation of press articles. See therefore Figure 14.

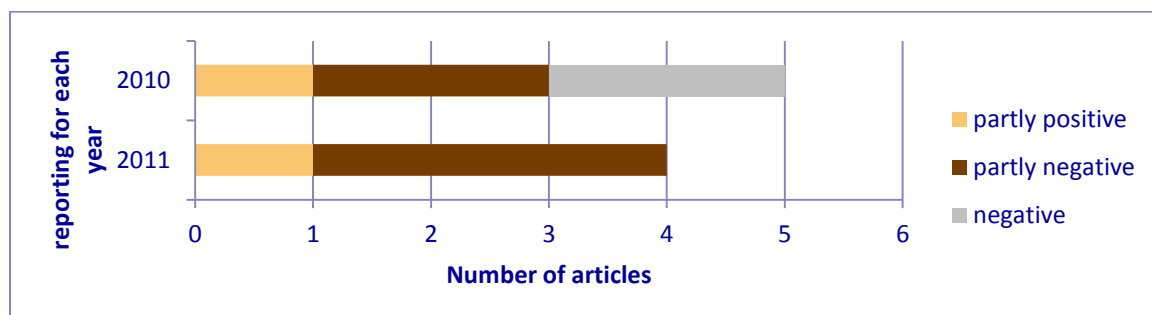


Figure 14: Reporting on the geothermal power plant in Brühl (Leucht 2012)

The press partly sees the potential of geothermal power, but the focus is rather on social acceptance problems in the city of Brühl. The reason for this conflict lies in an unaddressed demand for information, security and citizens’ participation over the whole project life, but especially after the seismic events in Landau. The project developers and the responsible persons within the municipalities did not see these needs and by this supported indirectly the formation of a strong citizens’ initiative (Leucht 2012).

## Landau:

Since the end of 2007 the geothermal power plant in Landau produces electricity and heat. With a production rate of 50-70 l/s and 160°C water temperature the power plant has an electrical capacity of 3 MW<sub>el</sub> and an additional heat capacity of another 3 MW<sub>th</sub> (geox GmbH n.d.).

For Landau the SA describes an ambivalent acceptance situation. After the project start in 2007 the public and political acceptance of the project was quite high. This changed with seismic events in 2009. After the seismic events a dispute about unjustified damage claims caused the formation of a citizens' initiative. This initiative is strongly against geothermal power in Landau and in any other place in Germany.

The main part of the population has reached a condition of tolerance towards the power plant. The experience shows that one can live with a geothermal power plant and the perception for risk is rather low. On the other side relevant stakeholders do not identify themselves with the locally and environmental friendly produced energy. The whole situation is caused by a purely technical approach of the project developer. The company did not see the necessity of pro-active communication until the seismic events, when the public opinion was already against the project developers (Wallquist and Holenstein 2012).

The MRA displays in Figure 15 very clearly the statements done within the SA. The positive attitude towards the power plant has changed in the press after the seismic event in 2009. The public interest can be seen by a very strong increase of press articles after the seismic events. On the other side one can see in 2011 a calming of the situation with a growing share of positive press releases.

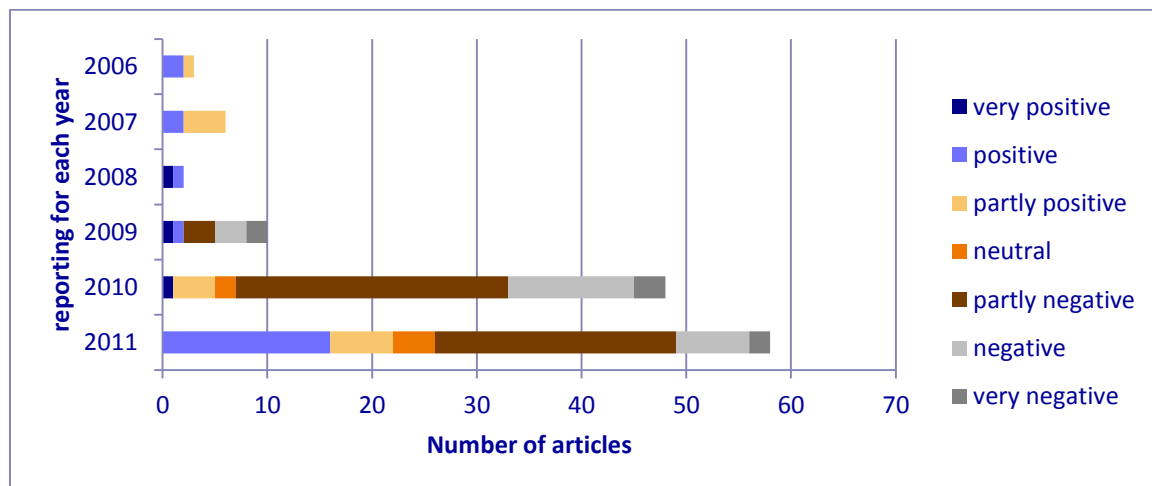


Figure 15: Reporting on the geothermal power plant in Landau (Leucht 2012)

The analysis of the print media has shown that Landau was the strongest project reference for a deep geothermal power in Germany before the seismic event. After the seismic event it became the strongest argument against deep geothermal energy usage. The project operators missed the possibility to initiate an information campaign that satisfied the



information needs of the public after the seismic events. Pro-active public relations activities did not take place. In the reporting about the power plant one can observe strong differences between local and superregional media. Whilst the regional media mainly reports about the seismic events a missing profitability or other negative aspects, the superregional press also saw Landau as an example for a working technology, which shows the potential of geothermal power (Leucht 2012)

### Unterhaching:

The geothermal power plant in Unterhaching is situated in the geological region of the Bavarian Molasse Basin. With a exploration rate of 150 l/s and a temperature of  $\sim 130^\circ\text{C}$  the power plant is able to produce a maximum of 3,36 MW<sub>el</sub> or 38 MW<sub>th</sub>.

In contrast to other investigated geothermal projects the power plant in Unterhaching is well known in the public. People have trust in the operators and identify themselves with the innovative technology in Unterhaching. Through the heat supply of more than 5000 households, people can literally feel the benefits of the technology. On the other side, problems with the pumps and seismicity at other geothermal power locations are seen, but not rated very high. As the project came out of the local community it was and still is deeply connected to the local public. At the beginning public relation actions were mainly based on single persons and word-of-mouth recommendation. With a growing heat network this aspect has been professionalized towards a pro-active communication.

Again the impression of the SA can be proved with the MRA. In Unterhaching a general positive attitude towards geothermal power can be observed as Figure 16 shows.

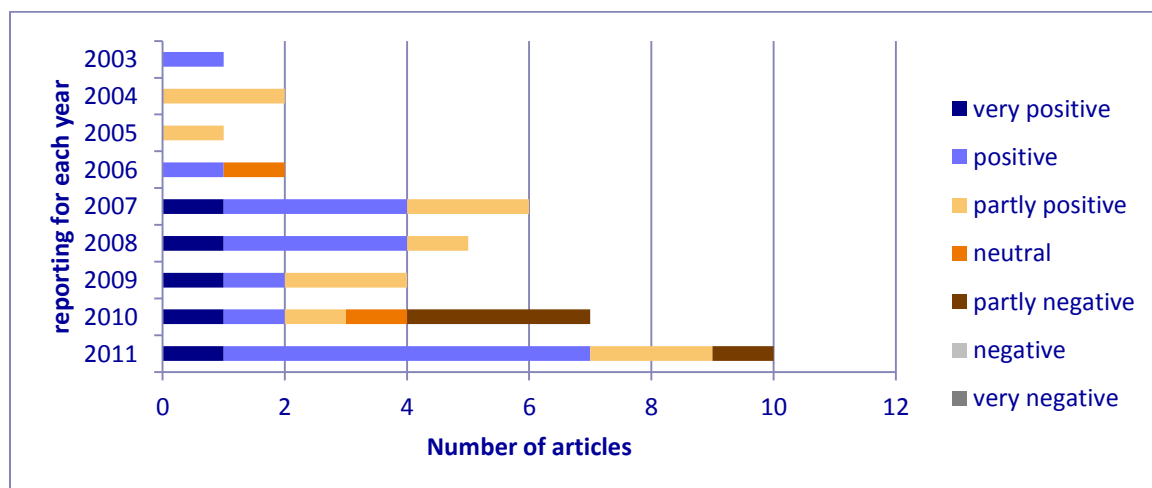


Figure 16: Reporting on the geothermal power plant in Unterhaching (Leucht 2012)

In the regional and superregional print media the Unterhaching project contributed to a positive picture of geothermal energy. But even at Unterhaching an impact of the Landau seismic events can be observed and first negative reporting can be found in 2009. Later the profitability of the plant is discussed in the public media. Nevertheless Unterhaching can be

described as a flagship project. The pro-active communication policy and a strong identification of the public with the project operator lead to high acceptance (Leucht 2012).

### 5.3 Case study France

The geothermal power plant in Soultz-sous-Forêts (Alsace, France) is a European research project. Since more than 20 years the power plant is a research location for geothermal energy. The uniqueness of the project is its EGS (Enhanced Geothermal System) character. The region around Soultz has been used for oil production since a long time, which led to a very extensive knowledge on the underground in this region. Since 2008 a power plant with a net power generation of 1.5 MW<sub>el</sub> is installed. The research effort spent by multiple and multinational organisations lead to a considerable knowledge and process improvement (GEIE 2012).

The power plant is situated a few hundred meters away from Soultz-sous-Forêts. The town lies about 50 km north of Strasbourg and has around 3000 inhabitants. It is situated in a hilly landscape without major industry.

Within the geothermal project Soultz-sous-Forêts, one traditionally has an open information policy and ensures a good relationship with the public. To understand the concerns and opinions of the affected citizens the power plant operator did a survey in 2012. The results of this survey are as follows.

Figure 17 presents the answers to a question asking for the risk awareness related to the geothermal power plant. It can be seen that over 80 % of the people do not see geothermal power as a risk, at all.

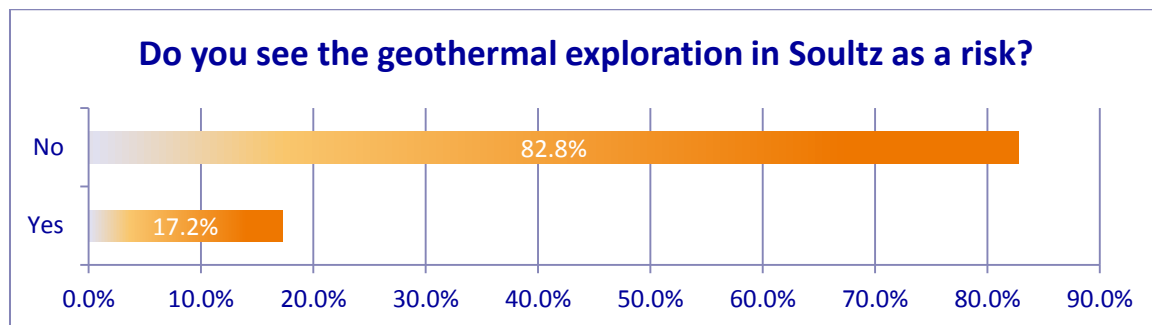


Figure 17: Risk through the geothermal power plant in Soultz-sous-Forêts (Genter and Cuenot 2012)

Concerning single risks, seismicity is identified as the top risk but is directly followed by noise pollution. Figure 18 also presents that age differences of the survey participants have hardly any impact on risk perception.

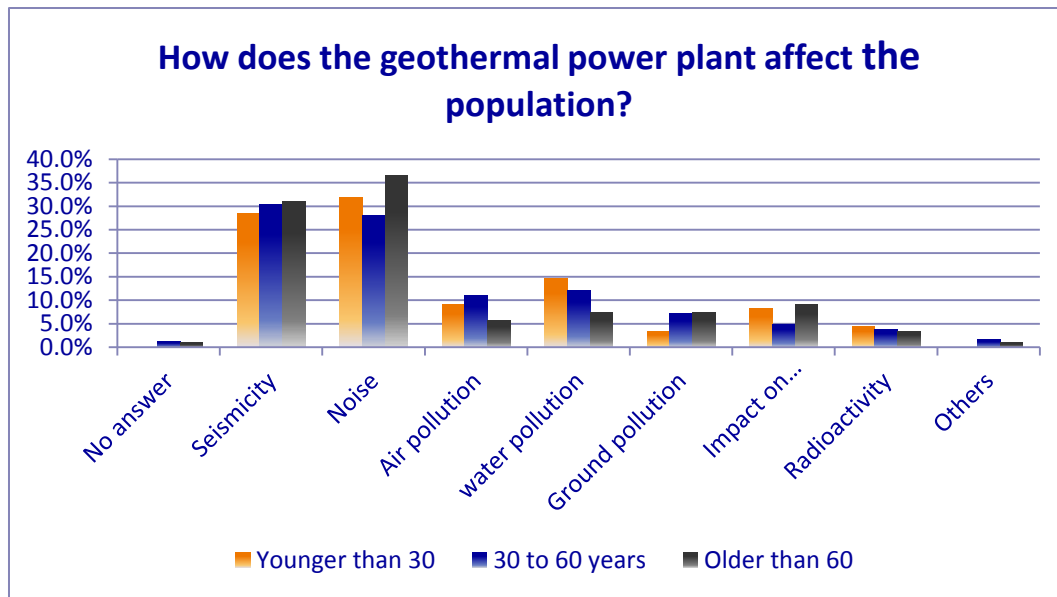


Figure 18: Effects of the geothermal power plant on the population (Genter and Cuenot 2012)

Figure 19 shows that only ~ 25 % of the survey participants have ever been disturbed through the geothermal power plant. Similar results have already been seen in Figure 17, when people were asked for their risk perception.

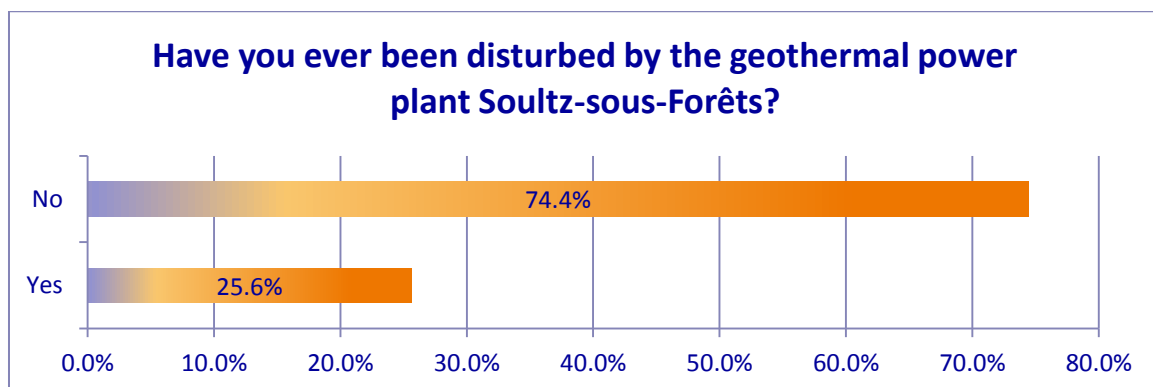


Figure 19: Disturbance by the geothermal power plant Soultz-sous-Forêts (Genter and Cuenot 2012)

It seems that this good acceptance has grown within the last few years. Figure 20 points out that the frequency of disturbances has been reduced considerably in the last few years. It can be concluded that the acceptance for the power plant has grown steadily since its beginnings in 1986. This might be linked to the reduction of seismic events throughout different project stages.

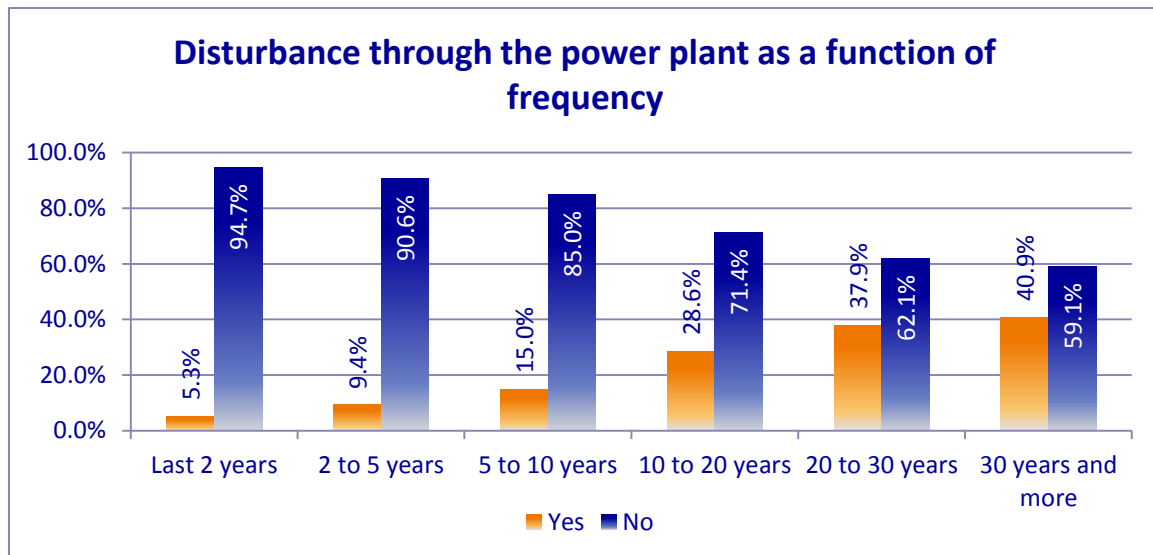


Figure 20: Disturbance through the power plant as a function of years (Genter and Cuenot 2012)

## 6. Recommendations and best practices

The goal of this report was not to write another guideline for social acceptance in renewable energy development. The authors see this report rather as a possibility to raise awareness for the topic of social acceptance within geothermal energy development. Guidelines for social acceptance of geothermal power are currently developed e.g. in the research project “Project for evaluation and improvement of public relations for geothermal projects”. EnBW participates in this project which is supported by the federal ministry for the environment, nature conservation and nuclear safety (Germany). A publication of the guidelines is expected in autumn 2013. General guidelines for social acceptance of renewable energies are for example published by (Haug and Mono 2012) or (Arndt, et al. 2013).

From the theoretical and practical examination of social acceptance issues in this report one can learn that information, participation, cooperation and consolidation are the backbones of a successful social acceptance initiative. In the following, the ideal implementation of a project is shown. Figure 21 therefore shows the different steps of project implementation and the actions that should be taken in social acceptance issues.

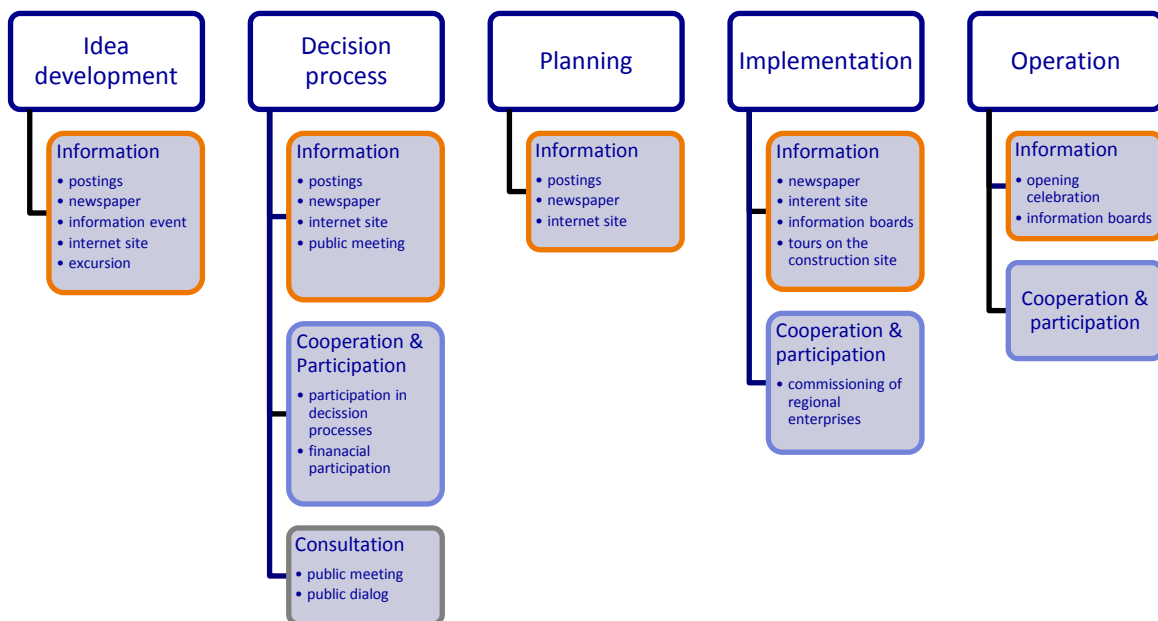


Figure 21: Implementation of renewable energies (Own illustration based on (Arndt, et al. 2013))

Right from the beginning the project should be offensively communicated within the public. The public should have access to several information channels like information events or the internet. In a second step the affected citizens should be integrated into the decision process. Therefore the implementation process should be explained. Affected citizens can contribute their ideas and fears can be relativized within an objective discussion. Additionally the community is informed about participation possibilities (e.g. financial

participation; direct heat applications). Throughout a location analysis the public is fully informed about the current development. For the final decision, affected citizens and the project developers come together and discuss possible consequences of the power plant. During the planning phase the public is informed on a regular basis. The construction phase is also marked by a steady, unrequested information stream from the developers. By contracting local enterprises, added value stays within the community. After the completion of the power plant a ceremonial opening is organized, and citizens can visit the power plant (Arndt, et al. 2013).

As a conclusion a profit oriented project can only be realized with the consensus of the local community. This consensus can only be gained by “acting in consonance with the dynamic conditions of the environment, and in the respect of the people's health, welfare, and culture” (Cataldi 2001).

## 7. Bibliography

Agentur für Erneuerbar Energien. *Akzeptanz Erneuerbare Energien*. <http://www.unendlich-viel-energie.de/de/panorama/akzeptanz-erneuerbarer-energien.html> (accessed 02 07, 2013).

Arndt, Melanie, et al. *Akzeptanz für Erneuerbare Energien - Ein Leitfaden*. guidelines, Straubing: C.A.R.M.E.N. e.V., 2013.

Cataldi, Raffaele. "Social acceptance of geothermal projects - problems and costs." *EC International Geothermal course*. Oradea, 2001. 343 - 351.

City of Basel. *Geothermie*. 18 May 2010.

<http://www.wsu.bs.ch/politikdossiers/geothermie.htm> (accessed March 22, 2013).

de Jager, David, et al. *Financing Renewable Energy in the European Energy Market*. Berlin: Ecofys, Fraunhofer ISI, TU Vienna EEG, Ernst & Young, 2011.

Devine-Wright, Patrick. *Reconsidering public attitudes and public acceptance of renewable energy technologies: a critical review*. research report, Manchester: Manchester Architecture Research Centre, University of Manchester, 2007.

Dowd, Anne-Maree, Naomi Boughen, Peta Ashworth, and Simone Carr-Cornish.

"Geothermal technology in Australia: Investigating social acceptance." *Energy policy*, 2006: 6301 - 6307.

Ekins, Paul. "Step changes for decarbonising the energy system: research needs for renewables, energy efficiency and nuclear power." *Energy Policy*, November 2004: 1891 - 1904.

Gaskell, George, et al. *Europeans and biotechnology in 2010 - Winds of change?* Brussels: European Commission, 2010.

GEIE. *Geothermie Soultz*. 2012. <http://english.geothermie-soultz.fr/geothermie-soultz> (accessed February 12, 2012).

Genter, Albert, and Nicolas Cuenot. *Projet géothermique de Soultz*. Kutzenhausen, 7 November 2012.

GeoEnergy GmbH. *GeothermieBrühl*. 8 February 2013. <http://www.geothermie-bruehl.de/de.html> (accessed February 13, 2013).

geox GmbH. *Projektinfo - Geothermiekraftwerk Landau*. n.d. <http://www.geox-gmbh.de/de/Projektinfo.htm> (accessed February 13, 2012).

Hagedoorn, Saskia. *Methodology for a sustainability analysis of geothermal power plants*. Utrecht: university Utrecht, 2006.

- Hauff, Jochen, Conrad Heider, Hanjo Arms, Jochen Gerber, and Martin Schilling. "Gesellschaftliche Akzeptanz als Säule der energiepolitischen Zielsetzung." *Energiewirtschaftliche Tagesfragen*, 2011: 85 - 87.
- Haug, Stefan, and René Mono. Akzeptanz für Erneuerbare Energien - Akzeptanz planen, Beteiligung gestalten, Legitimität gewinnen. guidelines, Berlin: 100 prozent erneuerbare stiftung, 2012.
- Heras-Saizarbitoria, Inaki, Ernesto Cilleruelo, and Ibon Zamanillo. "Public acceptance of renewables and the media: an analysis of the Spanish PV solar experience." *Renewable and Sustainable Energy Reviews*, 15 September 2011: 4685 - 4696.
- Hole, J. K., C. J. Bromley, N. F. Stevens, and G. Wadge. "Subsidence in the geothermal fields of the Taupo Volcanic Zone, New Zealand from 1996 to 2005 measured by InSAR." Reading, Taupo, Lower Hutt, 2007.
- Holm, Alison, Dan Jennejohn, and Leslie Blodgett. *Geothermal energy and greenhouse gas emissions*. Washington: Geothermal energy association, 2012.
- Huber, Stefanie, and Robert Horbaty. *IEA wind task 28 - Social acceptance of wind energy*. research report, Liestal: ENCO AG, 2010.
- Isenberg, Michael. "Respekt vor der Polizei schwindet." *Stuttgarter Zeitung*, 2011.
- Leucht, Martina. Medienresonanzanalyse - zu Projekten der tiefen Geothermie in Landau, Bruchsal, Brühl und Unterhaching. research report, Karlsruhe, Freiburg: EIFER; enerchange, 2012.
- Leucht, Martina. *Social Acceptance of Deep Geothermal Energy*. research report, Karlsruhe: EIFER Institute, 2011.
- Mannvit. *Environmental issues - GEOELEC*. Reykjavik: Mannvit, GEOELEC research project, 2013.
- Massachusetts Institute of Technology. *The Future of Geothermal Energy*. Cambridge (Massachusetts): Massachusetts institute of Technology, 2006.
- Mergner, Hanna, Lena Eggeling, Thomas Kölbel, Wolfram Münch, and Albert Genter. "Geothermische Stromerzeugung: Bruchsal und Soultz-sous-Forêts." *Mining + Geo*. Stuttgart: VGE Verlag, 2012. 666 - 673.
- Oduor, Jennifer. Environmental and social considerations in geothermal development. Sydney : FIG Congress 2010, 2010.
- Olympia, Polyzou, and Stamataki Sofia. *Geothermal Energy and Local Societies - A NIMBY Syndrome Contradiction?* Proceedings, Bali (Indonesia): World Geothermal Congress 2010, 2010.



Pellizzone, Allansdottir, De Franco, Muttoni, and Manzella. "Assessment of social acceptance of geothermal energy exploration in southern Italy." *European Geothermal Conference*. Pisa:, 2013.

Richman, Barak D., and Christopher Boerner. "A Transaction Cost Economizing Approach to Regulation: Understanding the NIMBY Problem and Improving Regulatory Responses." *Yale Journal on Regulation*, 2006: 30 - 74.

Rybach, Ladislaus. Geothermal energy: sustainability and the environment. Zürich: GEOWATT AG, 2003.

Scheer, Dirk, Sandra Wassermann, and Oliver Scheel. "Stromerzeugungstechnologien auf dem gesellschaftlichen Prüfstand: Zur Akzeptanz der CCS-Technologie." In *Akzeptanzforschung zur CCS in Deutschland: Aktuelle Ergebnisse, Praxisrelevanz, Perspektiven*, by Katja Pietzner and Diana Schumann, 2 - 18. Stuttgart: Oekom-Verlag, 2012.

Shibaki, Masahi, and Fredric Beck. *Geothermal Energy for Electric Power*. Washington: Renewable Energy Policy Project, 2003.

Svedin, Uno. *New Worlds - New Solutions - Research an innovation as a basis for developing Europe in a global context*. Lund: The Swedish research council for environment, agricultural science and spatial planning, 2009.

team ewen. Ergebnisse der Mediation Tiefe Geothermie Vorderpfalz - Akzeptanzbedingungen für Projekte der Tiefen Geothermie in Rheinland-Pfalz. Darmstadt: team ewen, 2012.

van den Hoven, Jeroen, et al. Options for Strengthening Responsible Research and Innovation . Brussels: European Union, 2013.

Wallquist, Lasse, and Matthias Holenstein. *Stakeholdernalyse Geothermie - Analyse von Einstellungen und Wahrnehmungsprozessen*. research report, Freiburg: enerchange, 2012.

Wüstenhagen, Rolf, Maarten Wolsink, and Mary Jean Bürer. "Social Acceptance of renewable energy innovation: An introduction to the concept." *Energy Policy*, 26 Febrary 2007: 2683 - 2691.