



Understanding social acceptance of geothermal energy: Case study for Araucanía region, Chile

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ABSTRACT

This research aims to explore public views and social attitudes toward the use of geothermal energy as a heating and electricity source in an area where the geothermal energy production technology has yet to be widely introduced. This case study focuses on the community that surrounds the Villarrica Volcano in the Araucanía region of Chile. This area is considered to be one of the six high enthalpy geothermal zones in the Chilean Andes with the highest potential for geothermal energy production but actual production is nearly non-existent. Taking a risk communication approach, this research includes in-depth semi-structured interviews with local stakeholders. It suggests that there is a low level of understanding of the technology involved in geothermal energy production, and it highlights social barriers such as lack of trust, spiritual relationship to volcanoes, and uncertainty about environmental impact as factors that affect risk and public perception.

1. Introduction

The energy industry in Chile is at a crossroad. On the one hand, there is an urgency to adopt the use of renewable energy sources due to the country's high dependency on oil imports and to the severe droughts that have affected Chile for the last seven years (CR2 report, 2015). On the other hand, there has been an increase in resistance movements, which highlight the social dimensions of energy technology and production, and the challenges of integrating national energy needs with the interests of local communities.

Following the global trend to diversify energy sources, Chile has invested in promoting renewable energy use. Solar power is the most commonly known and socially acceptable option worldwide (Gross, 2012). Meanwhile, geothermal energy is a lesser known option. Chile is an Andean country located along the Ring of Fire and has high geothermal potential, with an estimated capacity ranging between 3000 and 16,000 Mwe (I.E.A.C., 2009; Lahsen, 1986). While countries such as Costa Rica and Mexico utilize geothermal energy for electricity production – with an installed capacity of 207 Mwe and 1017 MWe, respectively (Bertani, 2015) – this kind of energy is still not well developed and not well known in Chile.

In this context, this research aims to examine levels of understanding, public perceptions and describe general attitudes toward geothermal energy. This work is a first approach to understanding what

factors affect the level of social acceptance of this resource in the country. Social acceptance is a crucial factor in the development of any energy project (Cataldi, 1999) and there is a limited empirical evidence of how this kind of energy is perceived in Latin American countries like Chile. This research focuses on the Araucanía region in Chile, particularly on the communities that surround the Villarrica Volcano. This region has more than eight volcanoes and around 20 hot springs that are used for recreational activities. The Villarrica Volcano is one of the most active volcanoes on the continent (Lara and Clavero, 2004; Stern, 2004). Araucanía is also home to 33% of the total Mapuche population in the country.¹

1.1. Geothermal energy in Chile

Geothermal energy is one of the least known energy sources in Chile, even though the country's geological characteristics make it an exceptional place for such energy development. Despite the fact that geothermal geologic exploration started in the 1920s (Tocchi and Tatio, 1923) and that the Chilean Geothermal Law 19,657 was enacted 16 years ago, high enthalpy geothermal production remains almost non-existent (Bertani, 2015).

There are several factors that have contributed to the paradox of Chile being a country with high geothermal potential but – as of yet – no great geothermal energy production. Saldivia (2012) argues that the

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¹ The Indigenous Law 19,253 recognizes the existence of nine indigenous groups in Chile. They are Mapuche, the Aymara, the Rapa Nui, the Atacameños, the Quechua, the Colla, the Diaguita, the Kawashkar and the Yagán. (Molina, 2012)

main barriers to developing high enthalpy projects in Chile are economic, legal, and institutional. He includes slow processing times for bids related to geothermal projects, short time frames for exploration, lack of public funds during the exploration stage, and lack of geothermal specialists working at relevant ministries and other institutions that deal with energy production. The scenario becomes even more complex if other factors – such as the lack of medium and long-term energy policies, and the absence of energy-related government initiatives – are included in the equation (Sanchez-Alfaro et al., 2015).

From a high enthalpy point of view, the Chilean geothermal concession market peaked in 2012 with 76 exploration concessions. However, the number decreased to 43 in 2016 (Sernageomin, 2017). The first Chilean geothermal plant – located at Cerro Pabellón in the Antofagasta region – was started March, 2017. The plant is operated by ENEL Latin American (Chile) and by Chile's National Oil Company (ENAP), and is expected to have an installed capacity of 48 MWe (ENEL, 2012). Low enthalpy geothermal production, on the other hand, has been met with less opposition in Chile but is still precarious. There is no national registry of geothermal direct use projects, but available data suggest a 19.91 MWt installed thermal capacity (Lund and Boyd, 2015). This energy has been mostly used for recreational purposes, specifically spas and swimming pools. Other direct use projects include the heating of the Voipir Ñancul public school in the city of Villarrica – which is heated by two geothermal heat pumps – and a public hospital in Talca, Maule region.

The 2009 El Tatio well blow out incident drew mass media attention and negatively affected the perception of geothermal energy, transforming it from an unknown energy source to an infamous one (Otero, 2015). An abrupt, strong steam discharge took place in a well at El Tatio field, which is an area with great geothermal potential, but is also an important tourist attraction located on indigenous territory. This discharge lasted for 27 days, reaching 60 m high. The Chilean Ministry of Environment requested an international assessment on possible effects to the geysers, the research was in charge of United Nations Development Programme (PNUD). The report pointed out that the geysers were not affected by the incident but that the situation could have been prevented. The report also highlighted an information gap among the company and local community. Since then, geothermal energy has gained some opposition among the general population in Chile. As Hornig (1993) points out, public attention is influenced by media attention, and media coverage shapes perceptions and opinions.

1.2. Social acceptance and risk communication

In the global renewable energy sector, social acceptance has been identified as one of the most powerful barriers to the implementation of new technologies (Cataldi, 1999; Wüstenhagen et al., 2007). Although in the literature there is not consensus about the definition of “acceptance” and it could be discussed from different disciplines, this research focus on local acceptance which implies an active or passive support from stakeholders (Wüstenhagen et al., 2007) and including opinions, actions and decisions. The definition of social acceptance as shifted from a market orientation to a socio-political approach (Fast, 2013). Conceptually, social acceptance has three dimensions: a) social-political, understood as the acceptance of the technology by stakeholders, the public, and policymakers; b) community, which relates to procedural justice and trust among stakeholders; and c) market, which refers to the relationship between consumers, investors, and firms (Hornig, 1993). Walker and Cass (2007) highlight ‘the public’, as a key stakeholder. They argue that this group has been historically simplified – reduced to simply protestors and supporters. Walker and Cass, however, offer a broader definition of the term which takes into account ten categories of ‘the public’: consumer, service user, financial investor, local beneficiary, technology host, energy producer, project participant, protestors, and supporters.

Generally, geothermal energy does not have a high level of social

acceptance like other kinds of renewable energy such as solar or wind (Popovski, 2003), and it has not played a significant role in public debates on renewable energy (Gross, 2012). Several studies have found that some of the main factors affecting geothermal acceptance include: limited public knowledge about the technology, unfavourable media coverage, concerns such as water use and seismic activity (Dowd et al., 2011), uncertainty about the reversibility and predictability of adverse effects on hot springs (Kubota et al., 2013), and low levels of community participation in consultation processes and project development (Carr-Cornish and Romanach, 2014).

Because public uncertainty and gaps of information affect the social acceptance of an energy technology, taking a risk communication approach that encourages active dialogue among stakeholders can offer fertile ground to undertake an empirical exploration about social attitudes toward geothermal energy. First of all, communication, as a symbolic action, can shape public opinion and perception as tool for negotiation. The concept of risk communication has not had long-standing use and can be read in different lights (McComas, 2006), however, this research adopts a democratic conceptualization. Risk communication is defined as an network, or interactive exchange of information among individuals, groups, and institutions (Carr-Cornish and Romanach, 2014; Grabill and Simmons, 1998) which “promotes a fair process, where the goal is mutual understanding among the interested parties and two-way exchanges takes place (McComas, 2006; Palenchar and Heath, 2007). Effective risk communication planning allows trust to build among stakeholders, enabling all involved parties to make well-informed decisions, and, therefore, empowers local communities (Fast, 2013; Scherer and Juanillo, 1989). This approach is proper to analyze a broad societal energy discussion because information and education practices takes place in an uncertain context (Corvello, 1988). Risk is also a complex concept. In this research, risk is not limited to physical assessment ‘but are also a reflection of the understanding of the social system and the actors playing roles within them’ (p.3), where context local beliefs, attitudes and values affect the interpretation of risk communication messages (Eriksen and Prior, 2011).

1.3. Villarrica, selecting the study area

This study took place in Villarrica, a city 746 km south of Santiago. Located in the Araucanía region, the natural landscape is one of its main attractions and includes 12 protected areas that extend over 291,784 ha. The city also encompasses the iconic Villarrica volcano (39° 25' S; 71° 56' W), a composite stratovolcano that is one of the most active volcanoes in the Southern Andes (Lara and Clavero, 2004; Stern, 2004). From a geological perspective, the Araucanía region is one of the six high enthalpy geothermal areas in the Chilean Andes with the greatest potential for production (Aravena et al., 2016). The city's total population nears 50,000 inhabitants, and there are numerous Mapuche indigenous communities in the surrounding area.

From a social and cultural perspective, this region is marked by a complex relationship between the state and indigenous communities. When the Spanish colonizers first settled the area in the 16th century, they founded Villarrica on Mapuche territory. Since then, indigenous resistance groups have fought for political autonomy, land restitution, and the recognition of customary rights.

In this socially and environmentally complex scenario, the relationship between the state, energy companies, and local communities is also tense. In 2015, nine wind energy, 20 hydroelectric, four bio-energy projects, and one exploration geothermal project were carried out in the region (ME report, 2015). Energy projects, in particular, have caused significant disagreement between local communities and the state. In 2015, at least nine socio-environmental conflicts took place in this area (INDH, 2015).

Two geothermal projects drew the attention of the local community in the Araucanía region. The first one started in 2009 in the small town

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