Adaptation of Social License Measurement and Analysis Techniques for Geothermal Usage and Development

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Keywords
Social license to operate, SLO, Geothermal energy, Direct use, Stakeholder analysis, Developmental challenges

ABSTRACT
The biggest non-technical challenges to the development of new geothermal resources come in the form of opposition from local stakeholders. This opposition comes as a result of competing values and interests, and is made even more complex by the variety of uses that are available for a given geothermal resource. In this paper, the authors apply measurement concepts from the established social responsibility framework of social license to operate (SLO). The measurement techniques used by SLO practitioners in more traditional extractive industries such as mining are also readily applicable to renewable energy development, and geothermal is one area that stands to benefit from such an application. In this paper, the authors measure the social license of two communities with geothermal resources that represent different usage strategies and development stages. Preliminary results are given for these measurements.

1. Introduction
A sustainable domestic energy portfolio must focus on the development of locally available renewable resources. There are many technical, economic, and social challenges that inhibit sustainable development, and each must be overcome in order to develop these resources. While attention is normally focused on the technical and economic challenges, it is often the lack of social will that ultimately accounts for the failure of projects. In order to more fully understand and mitigate social concerns and conflicts that may arise during the course of geothermal development, the industry should look to its counterparts in the traditional extractive sectors, who have developed frameworks for dealing with these kinds of challenges through the course of their existence.

Social license to operate (SLO) is a concept that has been used in other extractive industries such as mining and oil and gas for several years, and it has been developed as a framework
for stakeholder analysis and management (Moffat & Zhang, 2014; Prno, 2013; Thomson & Boutilier, 2011). SLO is commonly described in the literature as a dynamic and non-permanent manifestation of the perceptions, beliefs, and opinions that relevant stakeholders have toward a given project or entity (Mayes, 2015; Prno & Slocombe, 2012; Thomson & Boutilier, 2011). Boutilier and Thomson have been particularly focused on measuring the social license in mining projects and connecting the opinions of stakeholders to the social structures that make up the community (Boutilier & Thomson, 2009, 2011). They have used Mitchell et al’s (1997) definition of stakeholders—any individual or entity which may either affect or be affected by the actions of a focal organization or industry—to manage the complex and ambiguous concept of “the community”, and have built a sociological model of legitimacy and trust to describe level of social license that a focal entity has. SLO has great potential to be extended to the renewable resource sector, and in fact Hall has already applied the concept to wind farms in Australia (Hall, 2014).

In order to adapt the concept of social license to operate to the specific circumstances of geothermal energy, it is necessary to examine the geothermal industry itself, and its similarities to and differences from the traditional extractive sectors to which the term originally applied. Geothermal development, like mining, takes place at the focal point of social, economic, and environmental forces, which are often in tension with each other. Stakeholders with varying priorities and concerns struggle to negotiate this space in both cases, with varying degrees of success and compromise. The main difference between the two sectors comes from the variety of usage options that geothermal resources afford, as compared to those of an orebody. In mining, the decision of stakeholders ultimately rests on whether or not the orebody should be mined at all, and if so, then by whom? In geothermal development, the question of “who” is still relevant, but development is not necessarily a binary choice in this case. The many forms of direct usage, as well as the varying scales of electricity production (binary, single flash, EGS, etc.) give stakeholders a much wider range of options for collective decision making and resource ownership. Of course, these options are limited by the resource itself, and not every type of usage is available at every location, but any place where power generation is an option, many direct use schemes are viable as well.

In this paper, the authors propose to adapt the concept of SLO to geothermal development by measuring the SLO among stakeholders at two locations in varying stages of usage and development.

2. Methodology

We performed stakeholder interviews, attempting a census of stakeholders rather than a sample of the stakeholder population. These interviews were conducted by a primary interviewer and a clerk (for help with recording responses), and participation was voluntary and without compensation of any kind. In order to interview as many stakeholders as possible, we employed snowball sampling; a technique in which each stakeholder is asked to refer the interviewer to other individuals and organizations that they consider to be stakeholders. The references are then contacted and interviewed and asked for referrals as well. This continues until no new referrals are generated.

The survey has so far been performed in two locations, chosen to represent different usage states and different stages of development. The first site to be surveyed is Rico, Colorado, which was chosen as a location in the exploration/feasibility stage. The second site is the town of Tsuchiyu, located in Fukushima prefecture in Northeastern Japan, which is a
traditional *onsen* location that has recently installed a 400kW binary plant. *Onsen* is a Japanese word that describes the hot-spring spa and resort communities built around the direct use of geothermal springs for bathing and relaxation. In this section, we will provide the details of the surveys that were performed at each location.

The interviews were semi-structured with 3 sections related to community values, relationships between geothermal development and SLO, and the relationships between stakeholder organizations. Each interview took approximately 45 minutes, but varied slightly depending on the stakeholder. The first section, “community values,” focused on the priorities of the local stakeholders: when and why they came to the area, what challenges to communication stakeholders in the community face, etc. In section 2, we used a modified version of the questions designed by Boutilier and Thomson (2011) to measure the social license factors of trust and legitimacy (shown in Table 1). These questions are intended to be answered using a 5 point Likert scale representing the range of opinions from “strongly disagree” to “strongly agree,” with “agree/disagree in equal proportion” marking the “neutral” point (3 on the Likert scale).

### Table 1. SLO questions from Boutilier and Thomson, 2011.

<table>
<thead>
<tr>
<th>Generalized Stakeholder SLO questions</th>
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<tr>
<td>1. We are very satisfied with our relationship with the geothermal industry.</td>
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<tr>
<td>2. My (community / organization) and [focal organization] have a similar vision for the future development of this region.</td>
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<tr>
<td>3. We must have the cooperation of [focal organization] to achieve our most important goals.</td>
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<td>4. [Focal organization] listens to our opinions.</td>
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<td>5. [Focal organization] does what it says regarding our (community/organization).</td>
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<tr>
<td>6. [Focal organization] openly shares information related to us.</td>
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<tr>
<td>7. We can gain from a relationship with [focal organization].</td>
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<tr>
<td>8. In the long run [focal organization] makes a contribution to the welfare of the entire region.</td>
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<tr>
<td>9. [Focal organization] gives more help to those who are most affected.</td>
</tr>
<tr>
<td>10. The presence of [focal organization] is a benefit for us.</td>
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<tr>
<td>11. [Focal organization] takes our interests into account.</td>
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<tr>
<td>12. [Focal organization] shares decision making with us on matters of interest to my (community/organization).</td>
</tr>
<tr>
<td>13. [Focal organization] is fair to all.</td>
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<tr>
<td>15. [Focal organization] cares about our interests.</td>
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</table>

This section also included other questions designed to measure participants beliefs about the relative feasibility of geothermal power production compared to solar and wind, usage preferences (including direct use and power generation options), and other relevant stakeholder opinions.

Very early on in the interview process it became clear that unlike mining, the “geothermal industry” is too far from the public consciousness to be an effective standard of measurement for the SLO questions; the concept of who or what the geothermal industry is was too ambiguous for stakeholders to express an informed opinion on. In subsequent interviews, we defined the industry as “any individual, organization, business, NGO, or government committee or agency of any level who promotes or participates in geothermal development of any kind, including exploration, financing, construction, etc.” We then asked participants to explicitly tell us who they imagined the geothermal industry to be as they responded to the questions.
In each of the two cases explored below, the meaning of “geothermal industry” had different connotations. Stakeholders in Rico—which is still in early exploration—defined the geothermal industry to be primarily the research teams currently conducting geothermal exploration, but they also mentioned potential real-estate developers who may be interested in the resource in the future. Interestingly, stakeholders in Tsuchiyu made a distinction between the geothermal development companies that exist elsewhere in Japan and the locally owned “onsen heat” company that owns the recently completed binary power plant. This distinction will be further discussed in the results and conclusions sections of this paper, but as it relates to methodology, the authors chose to measure the SLO of the local onsen heat binary power plant.

The final section of the interview focused on the relationships between stakeholders. Again using the methodology of Boutilier and Thomson, stakeholders were asked to identify other stakeholders with whom they had a relationship, and then to evaluate that relationship based on two criteria: their satisfaction with the relationship and the degree to which they shared a similar vision for the development of the resource. Analysis of the resultant stakeholder network requires too much detail for the present treatment, but results from that portion of the census will be published at a later date. The next section will discuss the characteristics of each location, and examine the results of their surveys.

3. Results and Discussion

In order to test the ability of the SLO framework to adapt to the unique challenges and conditions presented by geothermal development, the methodology was applied in two case studies; Rico, Colorado in the United States, and Tsuchiyu, Fukushima prefecture in Japan. These areas were chosen as locations for a preliminary study in order to simplify the analysis and refine the SLO methodology. The objective of this study is to test the framework and identify the types of geothermal stakeholders that will likely be encountered in future studies, and therefore does not depend on the scale of development or the cultural context of the target location, although those factors will need to be carefully considered in future studies. The background of each case will be given here, along with preliminary analysis of the results, and some brief comparative discussion about the two cases.

3.1 Case study 1: Rico, Colorado, USA

3.1.1 Context

Social acceptance of geothermal has been somewhat problematic in parts of Colorado, especially when it comes to expansion from direct use to electricity production. The most notable example being at Mount Princeton in Chaffee County, where potential development has been put off several times due to local concerns (Taylor, 2010). In other places in Colorado, there has been some stakeholder conflict related to the expansion of direct use activities and exploration (Hudson, 2011).

Rico is a small town (pop ~250), located in Dolores County in the mountains of southwestern Colorado with a geothermal hot-spring located just outside of town. For the past several years, teams of researchers have been exploring Rico’s geothermal potential, with quite a high degree of acceptance from the town, who has its own geothermal committee. Historically a mining town, Rico has largely become a “commuter” town for many people employed in the nearby ski resort town of Telluride, and it is also home to several local artists. As with many such towns in Colorado, the mining and industrial chemical history of the town has been somewhat turbulent. Currently, the drainage from nearby mines is being
treated at a large remediation site just north of the town. Because of issues with historical mining, and because the term “Social License to Operate” had been used previously in the town by mining companies with very little public support, all uses of the term were replaced with “social acceptance” in the stakeholder interviews in Rico, in order to make a clear distinction between the historical SLO practices employed in the area and the measurement goals of this research.

3.1.2 SLO analysis

In Rico, 20 stakeholders—about 30% of all stakeholders identified through snowball sampling—were interviewed over the course of 10 days in August of 2016. Of those stakeholders, 11 were male and 9 were female. The majority of stakeholders were private citizens and business owners (as opposed to government or local organization representatives), although almost all stakeholders interviewed fulfill more than one role in the town. The SLO measurements from the Rico survey are shown in Figure 1. Overall, the geothermal industry (again, largely defined by stakeholders to consist of current exploration teams) has a high level of SLO in Rico, measured at 4.08. This score is calculated as the average of responses across all stakeholders for the 15 questions listed in Table 1. “Don’t know” responses are not necessarily indicative of a neutral position, and were therefore omitted in the calculation of the SLO score.

There are two features of Figure 1 that are particularly noteworthy: the first is the high level of agreement (and low level of “don’t know” responses) of the stakeholders with the statements in questions 3, 7, 8, and 10, and the second is the high rate of “don’t know”
responses to questions 5,9,12, and 13. In most cases, stakeholders related the first set of questions (3,7,8, and 10 in table 1) to the potential (future) benefits that exploitation of the geothermal resource would bring. This is not uncommon, as even in mining the exploration stage is expected to be a period of high social license due to the perception of economic benefits that development will bring.

The second set of questions (5,9,12, and 13 in table 1), elicited a high level of “don’t know” responses. These questions mostly focus on the transparency and past actions of the focal organization. Because the “geothermal industry” as a developer has not materialized in the area yet, there is little basis for stakeholders to judge their opinion on those statements. This was expected at the early stages of the interview process, but the questions were included anyway for methodological consistency with other cases (such as Tsuchiyu) that were planned to be performed with the same questionnaire. It should be noted that both groupings of questions ([3,7,8,10] and [5,9,12,13]) are only qualitatively assessed, as the response size was not large enough for a factor analysis, however, the second grouping largely agrees with the “institutionalized trust” factor reported by Boutilier and Thomson (2011). It makes sense that the level of institutionalized trust has not emerged in Rico yet, as the geothermal industry has not yet emerged as an institution.

One feature of the Rico stakeholder group that differs from that of Tsuchiyu discussed below is the degree to which private citizens that have no direct or immediate stake in geothermal development consider themselves and each other to be stakeholders. In the later development stage represented by the Tsuchiyu case, these private citizens have almost entirely been replaced by local organizations as the primary drivers of social license.

3.2 Case Study 2: Tsuchiyu, Fukushima Prefecture, Japan

3.2.1 Context

Direct use of geothermal hot springs (onsen) for bathing and cooking has been practiced for more than a thousand years in Japan, and in fact, it is mentioned in the oldest existing history of Japan, the “Kojiki,” written in 712 (Philippi, 2016). Accordingly, the practice has important historical and cultural significance to the Japanese people. Onsen are frequented by people for relaxation and for the health benefits that are believed to result from different onsen characteristics. The towns and villages that surround onsen rely heavily on the attraction for tourism, and in some cases the entire local economy is dependent on the existence of the onsen. The owners of the resources themselves are particularly wary of any new large-scale development that might threaten the flow of their hot springs. Kubota et al (2013) conducted a literature review and subsequent survey which found the lack of social acceptance of geothermal power by local stakeholders to be the primary barrier to geothermal development in Japan.

Tsuchiyu onsen is located just outside the City of Fukushima in the northwest of Fukushima prefecture in northeastern Japan (see Figure 2). After the Great East Japan Earthquake of March 2011, concerns about the effects of radiation from the Fukushima Daiichi Nuclear Power Plant led to a steep decline in tourism to the prefecture. Not just foreign tourism, but within Japan itself fear remains about the safety of travel to the area. As a result, towns like Tsuchiyu have lost a significant revenue—Tsuchiyu itself losing 5 out of 16 onsen hotels either to immediate damage from the earthquake itself, or to the subsequent loss of revenue (Movellan, 2015). Tsuchiyu onsen actually consists of two areas separated by a distance of about 20km: Tsuchiyu onsen town, and Tsuchiyu pass, which is further into the mountains. Both have geothermal wells, but most of the wells in the town are owned by a local
organization called the *Onsen* Cooperative Society, whereas the *onsen* hotels in the Tsuchiyu pass area each own and operate their own wells.

![Map of Tsuchiyu onsen area.](image)

**Figure 2. Map of Tsuchiyu onsen area.**

In the wake of the 3/11 disaster, the community of Tsuchiyu has sought to bolster its income through the development of geothermal energy and has subsequently built a 400kW binary power plant (Figure 3). This power plant (owned and operated by a local company called Tsuchiyu *Onsen* Energy Co. Ltd, a subsidiary of Genkiup Tsuchiyu Co. Ltd.) operates as part of a cascading system, as the geothermal fluid is sent to the *onsen* hotels in the town for direct use bathing after leaving the heat exchanger. The *onsen* cooperative society owns the wells and supplies hot water to the binary plant and ultimately to the hotels in town.

![400kW binary power plant in Tsuchiyu onsen.](image)

**Figure 3. 400kW binary power plant in Tsuchiyu onsen.**

Early interviews by the authors in Tsuchiyu led to the clarification of “geothermal industry” to specifically mean Genkiup Tsuchiyu as the focal organization. Most stakeholders made a distinction between “geothermal energy” and “*onsen* heat”, perceiving the former to be a large-scale external (outsider) corporate entity, and the latter to be a small-scale, locally
owned, community enterprise. The measured SLO of Genkiup was 3.84. The distribution of responses (by question) is shown in Figure 4.

3.2.2 SLO analysis

23 stakeholders were interviewed in Tsuchiyu (40% of identified stakeholders), which included all of the identified local stakeholders. Of those 23 stakeholders, 19 were male and 4 were female, 3 were younger than 40, 8 were between 40 and 59, and 12 were between 60 and 80. As mentioned in before in the Rico case, it is somewhat difficult in a survey population this small to differentiate the roles of each stakeholder, as many have multiple relevant affiliations. Local onsen owners accounted for 57% of the interviewed stakeholders, though some of those owners were interviewed as representatives of other organizations. The proportion of interviewees who actually represented individual onsen hotels was 35%, with local non-onsen business owners accounting for 17% and the remainder representing local organizations. It has proven difficult to obtain responses from external stakeholders who have less focused interest in the binary plant. Overall, Figure 4 shows a high level of SLO, with fewer “don’t know” responses, but more variability in the responses than were observed in the Rico results.

Overall, the stakeholders of Tsuchiyu have been very successful in bringing a new geothermal usage to their town with a high level of social license. The fact that the focal organization in Tsuchiyu is a local company helps to establish a feeling of communal resource ownership and a level of psychological identification in some of the stakeholders, who are now coming to view the binary plant as part of the identity of their community. This internal ownership allows Tsuchiyu geothermal stakeholders to be somewhat more insulated against external forces. It is also one of the keys characteristics that has allowed Tsuchiyu to be successful in bringing binary power generation to their region with little stakeholder dissent.

Figure 4. Overall SLO results in Tsuchiyu. Question numbers correspond to the questions listed in Table 1. FO stands for “focal organization,” in the case of Tsuchiyu, this refers specifically to Tsuchiyu Onsen Energy Co. Ltd. who owns and operates the binary power plant.
4. Summary

Overall, the social license methodologies used by Boutilier and Thompson and others in the extractive industries provide a viable framework for assessing the social acceptance of energy. Some adaptation is required, however, to account for the differences between the geothermal industry and the mining and oil and gas industries in which SLO has traditionally been used. For example, the variety of usages available for geothermal development means that it is critical to clearly define what is being measured, and what entity is the focal point for that measurement. In different stages of development, the focal organization is likely to shift from exploration researchers to developers to construction companies to operators, and the SLO of each entity will be distinct. For the continued sustainability and development of a geothermal resource, the SLO should be carefully monitored throughout. In order for a geothermal project to gain and maintain the social license to operate, it must ensure that transparency and communication are fostered among all stakeholders from the earliest possible opportunity. The practices and measurement techniques of SLO provide a strong basis for understanding and responding to stakeholder values, priorities, and concerns in geothermal development as well as the resource development sectors from which those practices come.

5. Acknowledgements

The authors gratefully acknowledge Dr. Masami Nakagawa and Mr. Katsuichi Kato for their help and cooperation, and Dr. Masahiro Oba for his help in conducting the interviews.

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