Revitalization of hot spring resorts in Japan through PPP-based geothermal power project

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Abstract. Despite Japan’s significant geothermal energy potential, its geothermal power development has been stymied for decades due to four major hurdles: (1) high upfront cost and risk of exploratory drilling, (2) long lead time due to surveys and environmental assessments, (3) rigorous regulations on national parks, (4) oppositions from local hot spring resorts. The government has been taking measures to accelerate the development with a constellation of supporting policies. But policies cannot break down the conscious barriers that have taken root in hot spring owners; it is in the hands of developers to make constructive efforts for consensus building. The authors, with the role as construction consultant and geothermal developer, are undertaking a geothermal power development project in Hirosaki City, Aomori Prefecture. The primary intent is to realize a vision where local people can benefit from their own geothermal resources, and the authors believe that “sharing the same vision which benefits all the interested parties” is the key to work together with the opposing hot spring owners. In the process of building a trust-based relationship with local residents, the priority has been to hear the needs from the local through dialogue and to think from a larger standpoint.

1. Introduction
Situated on the Circum-Pacific volcanic belt, i.e. the Ring of Fire, Japan has abundant geothermal resources lying underground. The country has been tapping into that resources for more than a thousand years as communal hot spring baths, known as Onsen. But after experiencing the 1970s oil crisis, as a nation with few natural resources and has long been dependent on importing crude oil and natural gas, Japan renewed its view of geothermal resources as an alternative energy source for power production.

1.1. Background of geothermal power development in Japan
Considered as one of the renewable energies, geothermal power is domestic, stable (unlike solar and wind power, it can be operated 24 hours a day, seven days a week, not affected by the weather), low in carbon dioxide emissions and high in generating efficiency[1]. Japan’s potential for geothermal power generation is estimated to be 23,470 MWe, ranks as the third largest in the world behind the United States and Indonesia (as shown in table 1). And three Japanese companies — Toshiba Corp.
Mitsubishi Heavy Industries Ltd. and Fuji Electric Co., Ltd. — hold about 70% of the global market for the manufacture of geothermal turbines. However, while Japan is in a prime position to utilize its abundant geothermal resources, its combined output accounts for no more than 2.20% of its potential and 0.30% of the total power generation [2].

| Country                  | Estimated Potential (MWe) | Total Installed Capacity (MWe) | Resource Utilization Ratio (%) |
|--------------------------|---------------------------|-------------------------------|--------------------------------|
| United States of America | 30,000                    | 3,639                         | 12.1%                          |
| Indonesia                | 27,790                    | 1,948                         | 7.0%                           |
| Japan                    | 23,470                    | 525                           | 2.2%                           |
| Philippines              | 6,000                     | 1,868                         | 31.1%                          |
| Mexico                   | 6,000                     | 951                           | 15.9%                          |
| Iceland                  | 5,800                     | 755                           | 13.0%                          |
| New Zealand              | 3,650                     | 1,005                         | 27.5%                          |
| Italy                    | 3,270                     | 944                           | 28.9%                          |

There are four major hurdles that have been stymieing the geothermal power development in Japan: 
(1) high upfront cost and risk of exploratory drilling, (2) long lead time due to surveys and environmental assessments, (3) rigorous regulations on national parks where approximately 80% of Japan’s geothermal resources are concentrated, (4) oppositions from local hot spring resorts.

Over the years, the government has made tentative moves to accelerate geothermal power development. Especially after the Great East Japan Earthquake in 2011, the government is more convinced and committed to making full use of the country’s geothermal energy potential. They have introduced a constellation of supporting policies, e.g. establishment of the FIT system [2], subsidies for the initial investigation stage [4], loan guarantee system for the development and construction stage [5], shortening of the environmental assessment period [6], and deregulation for the development within national parks [7]. With these encouraging policies in place, the government expects to triple geothermal power generation capacity and sets the target to 1.0-1.1% of the total power generation by fiscal 2030 [8].

1.2. The conflict between developers and hot spring resorts

Although three out of four major hurdles have been lowered with the support of national policies, geothermal resource developers still face a powerful opponent: hot spring owners. Policies can only support up to the regulatory and financial obstacles, cannot break down the conscious barriers that have taken root in hot spring owners. Since hot spring bath has been at once a traditional culture resource and an important tourist resource for Japan, hot spring owners have a strong voice when it comes to concerns about geothermal power development.

The reason for their opposition is simple. Inasmuch as the depth of drilling is inherently different (a few hundred meters for hot spring, 1,500-3,000 meters for geothermal power generation), hot spring owners fear that geothermal development for power generation could dry out the hot aquifers that fuel their hot springs. Developers claim that they are utilizing geothermal reservoirs in different layers; thus there is no direct impact on hot springs, but their mere one-sided clam gains little credibility from...
the concerned hot spring owners. For decades, with lack of concrete verification supported by technical monitoring data, debates fail to narrow their differences. Opposition from hot spring resorts remains the major bottleneck in the course of geothermal power development.

Now that development environment has been improved and momentum has been fostered, it is in the hands of developers to take constructive measures for consensus building with hot spring owners: a consensus not only for the accedence to the geothermal power development, but for a mutual vision and purpose that would contribute to the society as well as all the interested parties.

2. Geothermal power development project in Hirosaki city

The authors, with the role as construction consultant and geothermal developer, are undertaking a geothermal power development project (hereinafter, referred to as the Project) in Hirosaki City, Aomori Prefecture. This case study shows the implementation of Public-Private Partnership (PPP) based geothermal power development project which aims to contribute to regional revitalization and the initiative for consensus building in the early stage of development.

2.1. Aim of the project

The Project aims for geothermal power development that is linked with the regional development of the city. In other words, it aims not to exploit the local geothermal energy, but to realize a vision where local people can benefit from their own geothermal resources, e.g. effective cascading (multi-stage) use of hydrothermal water for common regional interests. To achieve that goal from a larger standpoint, it is crucial to form a public-private partnership with the local government and work together hand-in-hand to build a visionary consensus with hot spring owners.

With this intent in mind, the authors have been undertaking the Project over a span of three years, and have focused on establishing trust-based relationship with the local government as well as the hot spring owners. The priority has been to hear the needs from the local through dialogue and to look toward the future of the hot spring resort area, extending beyond technical consulting for geothermal power development. Because the authors believe that “sharing the same vision which benefits all the interested parties” is the key to work together with opposing hot spring owners. As the outcome of the effort, the Project created an energy vision for the target region and successfully gained local understanding in collaboration with the local government.

2.2. Regional analysis and the measures

In general, developing a geothermal power plant takes approximately 10 years from the beginning to its completion. So the initial surveys and evaluations are critically important for setting the right direction of the project. And since the aim of the Project is linked with local revitalization of Hirosaki City, the authors conducted a SWOT analysis of the potential around the planned development area including hot spring resorts. The analysis indicated an obvious decline in regional activity due to the rapid aging of the population. In fact, with a population of 170,000, Hirosaki City ranks as the second highest in Japan for the aging rate [9]. Also, the number of local hot spring lodgings has dropped to seven from 15 in the past few years.

Stagnated hot spring resort area showed little interest in new initiatives and wanted no risk that might weigh burden on their existing hot spring businesses. The first step was to bring them to the table to start the conversation, and in order to encourage their involvement, a measure that would appeal to their interests was needed. One noticeable fact was that there was a wide technical knowledge gap between the hot spring owners and the same went for the local government officials who were in the role to moderate the consensus building. After deliberation, an open workshop named Hot Spring Community College was organized.

In the form of workshop, local residents including hot spring owners, local government officials, local university professors, and construction consultants have all gathered together under one roof for the same theme of “distinctive natural blessings of the region”. On top of providing an informative learning opportunity, it became a place to share common awareness of the regional issues, and to take
bottom-up approach toward regional revitalization. Also, based on the results of geothermal resource quantity investigation that was being conducted in parallel, multiple plans with different resource quantities were introduced to help the participants in getting the image of possible scenarios for geothermal power development (as shown in figure 1).

Figure 1. Business development and hot spring community college.

3. The hot spring community college initiative

For the Project, the immediate purpose of the Hot Spring Community College initiative was to foster the momentum for geothermal power development. However, while seeking respective merits, all the participants (locals, officials, academia, and the private sector) shared the same objective, i.e. community and local revitalization, through crossover dialogues during the workshop. Geothermal energy was presented as a regional resource to be leveraged from a larger standpoint. In other words, the Hot Spring Community College fulfills a role as an incubator that makes use of geothermal energy to hatch the “egg” that gestates revitalization ideas out of regional features (as shown in figure 2). And through public-private partnership, the Project was adopted by the national program to promote understanding of geothermal energy [10].

3.1. Year one

The Hot Spring Community College was held under two time frames with four sessions for each frame. The contents for the first year were the following: (1) successful precedents for community revitalization with hot spring power generation, (2) successful initiatives for revitalization in hot spring resort area, (3) site visit and multi-stage utilization of hot water, (4) know-how for community-led
regional development lectured by the prominent hot spring producer who brought Kurokawa Onsen in Kumamoto Prefecture into national fame.

According to the anonymous questionnaires conducted at the end of each workshop, 84% of respondents indicated that their understanding of geothermal power generation had deepened in general. And the most noteworthy achievement owing to the initiative is the fact: a deep drilling survey to a depth of over 1,500 meters was smoothly conducted with local residents’ consent near a hot spring resort area where had strongly opposed to a non-drilling surface survey before the workshop.

**Figure 2.** Concept image of hot spring community college initiative.

**Table 2.** Agenda of hot spring community college.

| No. | Year One | Year Two |
|-----|----------|----------|
| Part 1 | Community revitalization through local energy | Conceptions and visions for local areas |
| Part 2 | Seeking commercialization of local energy | Ideas for secondary usage of hot water |
| Part 3 | Methods for utilization of geothermal resources, hot springs resources | Presentation of future vision for the area and exchange of views |
| Part 4 | Coordinating community-led regional development | Review of Future Vision |
3.2. Year two
But from the same questionnaires, an issue that cannot be overlooked was indicated. Local young people in their teens to forties felt unable to actively speak up their frank opinions in the presence of elder people with statuses and titles, e.g. hot spring owners and community association chairpersons.

Responding to this concern, the workshop for the second year were intentionally designed for the younger people (twenties to fifties) with more creative and participant-driven content as the following: (1)open discussion regarding current condition and image of the community, (2)constructive ideas for the secondary usage of hot water, (3)Presentation of future visions for the area, (4)review of the future vision for the community. And as the outcome of the workshop, ideas and visions proposed by the local residents were visualized into the Geothermal Energy Utilization Map (as shown in figure 3).

![Geothermal Energy Utilization Map](image)

**Figure 3.** Concept map for geothermal energy utilization.

4. Conclusion and similar implementations
National supporting policies regarding geothermal power development have revived sluggish market for the industry. But for smooth sailing in this following wind, geothermal developers should change their course of action to find common ground with hot spring owners. Simply put, creating benefits for local residents are the priority to be taken into consideration in the course of development.

Commonly, usual measures for gaining consent from local residents and hot spring owners have been in the form of direct benefits, e.g. monetary settlements as site rental fees, deposit and guarantee for drilling supplementary wells. But it’s been proven from the Hot Spring Community College initiative in Hirosaki City that sharing the vision together is the most constructive way for all the interested parties, and in its process a trust-based consensus will naturally be built.

Through the workshop, local residents have recognized problems, challenges, backgrounds, and current conditions, and have come together to create a future vision for the community with the hope of revitalizing their hot spring resort area that has fallen into severe decline. They now acknowledge
that efficient geothermal resource utilization such as hot water greenhouse, snow melting system and public bathing facilities could be the key to spark off community revitalization. And their momentum toward geothermal power development has increased significantly as we can feel their expectation for a positive outcome of the undergoing energy potential survey. Even if the outcome of the survey did not meet the required standard for power plant construction, they are earnestly planning for greenhouse agriculture and new public bathing facilities using the hot water from exploratory wells which were drilled for surveys. What’s striking is that they are acting on their own volition with no need to be initiated by the developer or the government. So far, without regard to the success of geothermal power plant construction, seeing changes in local residents from being disinterested to becoming self-driven through the initiative is already a worthwhile result for this PPP Project.

As consultants, the authors have successfully gained understanding and consensus for geothermal power development from local residents with trust in other areas (Myoko City, Niigata Prefecture; Mutsu City, Aomori Prefecture) where local revitalization was considered as the priority in the same manner. And with PPP method, geothermal potential surveys have been conducting smoothly in collaboration with local government authorities.

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