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Comparison of geothermal utilization for tourism activity: What can we learn from New Zealand, Iceland, Japan, and USA

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Abstract

A part from electricity generation, geothermal energy can be utilized for other direct use application such as bathing, heating, agriculture products drying, and also as tourism objects. As one of the countries that has a vast geothermal energy potential, Indonesia has an advantage as a tourism destination. However, compared to other countries that are rich with geothermal sources such as New Zealand or Iceland, Indonesia is still lagging behind in the promotion of its geothermal surface features as a tourism destination. There are relatively a few well-known geothermal tourist destinations in Indonesia compared to Indonesia's numerous geothermal areas. This paper reviews and compares the geothermal utilization as tourism purpose in New Zealand, USA, and Iceland. Examples from famous geothermal tourism places such as Yellowstone (USA), Rotorua and Taupo (NZ), and Blue Lagoon (Iceland) are reviewed, and the approach used by these countries to promote and develop geothermal tourism are also discussed and summarized. Finally, this paper tries to summarize what are the approaches that can be used by Indonesia to further develop its geothermal resources as tourism objects, and the possibility to pair geothermal tourism closely with education and industrial energy use.

Introduction

Brief history of geothermal direct use utilization in Indonesia

Indonesia is a country with the highest potential of geothermal energy in the "Pacific Ring of Fire" which is characterized by the spread of geothermal manifestations around Sumatera, Java, Nusa Tenggara, Sulawesi, Maluku and Papua. Some sources of manifestation are used to produce electricity, but others can be used directly. Geothermal resources are generally located in mountainous regions with agricultural land (including plantations), forestry, bath and spa resorts, etc. very potential for various direct use applications, especially for geo-tourism.

According to Geothermal Energy Law (Law No. 27/2003), geothermal energy must also be developed for direct use, but until now implementation in Indonesia is still very low. Applications for direct use of geothermal energy can contribute significantly, as well as improve the standard of living of the local community. Many the local government has begun identification potential direct use in their administrative area. With the existence of a law on geothermal energy which also regulates

direct use, then Indonesia should be able to optimize the potential of geotourism in Indonesia. In this paper reviews and compares the geothermal utilization as tourism purpose in New Zealand, USA, Japan and Iceland.

Several examples of geothermal direct use utilization around the world

Geothermal energy can be used indirectly or directly. Geothermal can be indirectly used to electricity, Direct-use applications exist on a scale ranging from heating and cooling households and large industrial and institutional buildings to commercial uses for aquaculture, resorts/spas, and greenhouses. Geothermal direct-use is very compatible with Indonesia's needs in industrial use, agricultural lands, bathing and spa resorts, which all require heat. Direct use of geothermal energy is one of the oldest, most versatile and common forms of utilizing geothermal energy (Dickson and Fanelli, 2003). The early history of geothermal direct-use has been reviewed for over 25 countries in the Stories from a Heated Earth – Our Geothermal Heritage (Cataldi, et al., 1999), that documents geothermal use for over 2,000 years (Mineral and Mining, Directorate for Energy Resources, 2014).

The direct use of geothermal energy has significant economic, environmental and social benefits, chiefly because it reduces electricity demand as it replaces electric-driven heating and cooling applications. Although using direct geothermal energy does not generate electricity, it is a more efficient form of energy as the fuel undergoes only one energy conversion rather than the several that occur in electricity generation usage. Geothermal Direct use also does not emit carbon and thereby helps reduce Indonesia's carbon footprint. In direct use systems, a shallow well is drilled into a geothermal reservoir to provide a steady flow of hot water. The water is normally pumped to the surface and flows through a mechanical piping system which uses a heat exchanger in order to deliver the heat directly for its intended use. A disposal system then either injects the cooled water back into the subsurface or disposes of it on the surface. (Mineral and Mining, Directorate for Energy Resources, 2014)

The following are examples of direct use of geothermal energy in developing countries such as Indonesia that has been supported by the government is Lahendong which is famous for the Lake Linow and Kamojang as an educational park. Another example that has not been supported by the government is the hot spring baths

Data and Method

Literature review regarding:

Type of geothermal system, manifestation, and its utilization in NZ, USA, Iceland.

United States is located on active extensive margin (most of it is transform) geological setting with fault controlled geothermal system. The common manifestation in United States are hot springs, fumaroles, or altered ground (Garg et al, 2010). In United States, geothermal energy is used as direct and indirect utilization. The first indirect utilization of geothermal energy in United States was started in Yellowstone from 1960 (Garg, Pritchett, & Combs, 2010). United States current capacity is 62 MW in 2019

New Zealand is located on active margin geological setting with low terrain geothermal system. The common manifestation in New Zealand are hot springs, silica sinter, or altered ground (Brotheridge et al, 1995). The first utilization of geothermal energy in New Zealand was started from 1958 (Hochstein, 1995). In New Zealand, geothermal energy used as direct and indirect utilization Currently, New Zealand geothermal installed capacity is 17 MW (2019).

Iceland is located on active extensive margin geological setting with high enthalpy geothermal system. The common

manifestation in Iceland are hot springs or warm ground .The first utilization of geothermal energy in Iceland was started from 1969. In Iceland, geothermal energy is used as direct and indirect utilization. (Ibrahim, 2004) And currently, Iceland geothermal installed capacity is 755 MW (2018).

Japan is located on active margin geological setting with volcanic geothermal system The common manifestation in Japan are hot springs, fumarole, or warm ground. The first utilization of geothermal energy in Japan was started from 1966. In Japan, geothermal energy is used as direct and indirect utilization, but the main utilization is direct utilization. (Suga, 2017). And currently, Japan geothermal installed capacity is 542 MW (2018).

Economic impact of geothermal tourism in those countries

The tourism sector is important for the development of a nation's economy, with main benefits being income for local residents around geotourism locations. Economic impacts associated with tourism arise as a result of the demand and supply relationships in the industry, the associated visitor and investment expenditure patterns that they stimulate, and the structure of the economy. (Erfurt-cooper, 2010)

Examples and Benchmarking:

New Zealand, Whakarewarewa

The Whakarewarewa area in the southern area of the Rotorua Geothermal Field and contains 500 hot springs, 65 geyser vents, colourful sinter terraces and vegetation unique to geothermal areas. Whakarewarewa is an iconic centre of Māori culture and of geothermal features in the New Zealand. Residents at Whakarewarewa over the decades have witnessed an evolution in geothermal and cultural tourism. The Tuhourangi / Ngāti Wāhiao people have a proud heritage which they share with visitors from around the world.



Figure 1: The activities in cultural village Whakarewarewa (The living cultural village Whakarewa-rewa Web, 2019)

The Whakarewarewa Thermal Village Tours continues to grow, with profits supporting growth within the village environment. The Whakarewarewa thermal area occurs in the southern part of the Rotorua Geothermal Field, inside the margin of the Rotorua Caldera and beneath Pohaturoa rhyolite dome (Neilson, Bignall, & Bradshaw, 2010)

Whakarewarewa Valley is an active geothermal area with hot pools, boiling mud and geysers. Māori people have lived here for centuries, co-existing in harmony with the geothermal forces that lay beneath their feet. Their facilities were Māori cultural performance, nature walks, traditional food, overnight marae stay, and hot water beach campground.(The living cultural village Whakarewa-rewa Web, 2019)

Established in 1901 as an experiment to test the suitability of different native and exotic forest species for commercial planting, Whakarewarewa is home to a large number of native plant species as well as giant Californian Redwoods. Today it's known as a walking, running, horse riding and mountain biking destination. Hundreds of jobs could be created in Rotorua, and millions of dollars of private investment sparked, following a multi-million dollar cash injection from the Government.

People who ride (locals and visitors) in Rotorua's Whakarewarewa forest contribute between $30m and $50m in spending annually to the local economy, creating 200 to 350 jobs. Tourism spending is estimated at $310 million annually in the District and, when flow-on effects are considered, generates approximately $463 million in benefits to the District economy (Simmons, 2000)

Iceland, Blue Lagoon

The Blue Lagoon was formed in 1976 following the operation of Hitaveita Suðurnesja (today HS Orka hf) – the local environmentally friendly geothermal power company. It is located on the Reykjanes Peninsula in south-western Iceland that is primarily composed of porous lava. The Blue Lagoon history dates back to 1976 when it formed next to the geothermal power plant, Svartsengi. The Blue Lagoon was first created when hot brine from a nearby geothermal power plant was discharged into the near lava field. Soon after the lagoon had been formed, its healing effects on patients were discovered. (Gudmundsóttir, Brynjólfsdóttir, & Albertsson, 2010)

Blue Lagoon offers visitors a range of services including in-water spa treatments and massage and access to geothermal steam baths, saunas, a geothermal waterfall and an indoor pool. Restaurant service is offered at the Lava restaurant built into the lava cliff surrounding the Blue Lagoon. (Gudmundsóttir et al., 2010)



Figure 2: The facilites of Blue Lagoon, Iceland (Blue lagoon Iceland Web, 2019)

The Blue Lagoon is renowned for its simplistic, respectful architecture reflective of Icelandic Modernism.HS Orka hf has been a lead investor in the Blue Lagoon since the company's foundation in 1992. Together, the companies have amassed valuable operational and scientific know-how that flows seamlessly between the companies. The employees of both companies are building up valuable experience and knowledge in the area of harvesting geothermal energy. (Gudmundsóttir et al., 2010)

Japan, Beppu

The Beppu geothermal area is located in the eastern edge of the Beppu–Shimabara graben that crosses from northeast to southwest on Kyushu Island in Japan. Geologically, Beppu is one of the largest water-dominated geothermal systems in Japan, and it extends up from the Mt. Tsurumi–Mt. Garan volcanic center to the east coast of Beppu city, which is fed by geothermal fluid beneath the volcanic center of Mt. Tsurumi and Mt. Garan. The city of Beppu is a hot spring area with the largest water discharge in Japan. The discharge of hot water coming out in the Beppu spring is ranked second in the world after Yellowstone National Park in the United States. (Mia, Fujimitsu, & Nishijima, n.d.)



Figure 3: The facilites of Beppu, Japan (Japan Hoppers Web, 2019)

USA, Yellowstone National Park

Yellowstone National Park is one of the best known destinations for geothermal tourism and

contains the largest concentration of geothermal features in the world (Rhinehart, 1980), with around 100 different hot springs groups totalling over 10,000 individual thermal features (Bryan, 1986). The terraced Mammoth Hot Springs with over 100 hot springs cascading over a number of travertine terraces are one of the most popular tourist attractions in Yellowstone. The facilities on Yellowstone National Park are ranger programs, camping, day hiking, photography, bicycling, boating, fishing, horseback riding, wildlife watching and skiing. (Bargar et al, 1975)

Yellowstone National Park is a big place—over 2.2 million acres (nearly 900,000 hectares). Within the park boundaries are some of the world's most amazing hydrothermal features, dramatic waterfalls, and the heart of one of the most intact temperate ecosystems left in the world. to help you explore Yellowstone, there are five entrance stations, ten visitor centers, eight developed areas with lodges, restaurants, and stores. (Simoni, n.d.)

Yellowstone economic impact of $647.1 million. Visitor spending on lodging supported more than 58,000 jobs and more than 61,000 jobs in restaurants. Visitor spending in the recreation industries supported more than 28,000 jobs and spending in retail supported more than 20,000 jobs.



Figure 4: The Yellowstone National Park, USA (Yellowstone National Park Web, 2019)

Existing geothermal tourism object in Indonesia and their features.

The most common and traditional usage of geothermal energy in Indonesia is for balneology, bathing and heated swimming pools.

Kamojang

Kamojang is one of few places that has successfully developed geothermal power generation as well as multiply its benefits thus impacted in an increase in the local economic growth. Kamojang crater is a crater that occurs because of the earth's steam blast, and also a kind of geothermal surface manifestation. different from the crater that exist because of the former volcanic eruption. (Adityatama, Purba, & Kristianto, 2018)



Figure 5: Kamojang, Indonesia (Native Indonesia Kamojang Web, 2019)

The impact of power generation in Kamojang has contributed in creating many facilities, there are water (lake) attraction, cultural tourism, forest tourism, and indigeneous village tourism (Zainuddin, 2016).

Local tourism has slowly increased since geothermal development started. The facilities have been used for festivals that represent local customs such as ornamental sheep (domba-hias) and many others.

Lahendong

Lahendong Geothermal Field Tomohon, where the Lahendong geothermal field is located, is a

city in North Sulawesi Province. Pertamina Geothermal Energy has plans for utilize excess steam or salt water from the separator in Lahendong for commercial copra production. Pilot plant for drying coconut meat (copra) built by Pertamina, and operational experiments provide good results.(Hasan & Wahjosoedibjo, 2015)

Lahendong hot water bathing pool is made by the local community to take the advantage of the beauty from the dense pine forest and its location that has hot springs containing sulfur. Lahendong is not far from Lake Linow, the lake that can change color due to the high sulfur content. (Utami et al., 2011)



Figure 6: Lahendong, Indonesia (Indonesia KayaDanau Linow Web, 2019)

The development of Lake Linow as an eco-tourism spot by a local private company since 2009 is beneficial for the proposed geothermal education park as it provides well maintained public facilities.(Utami et al., 2011)

Cipanas Garut

Currently, the popularity of Cipanas Garut began to be displaced by the presence of several Attractions in Garut around the area of Puncak Darajat Crater Garut which provides fresh air and beautiful scenery and the availability of a Natural Hot Water Pool. There are also outbound facilities for those who like adventure activities. Various games that invite adrenaline and build togetherness like flying fox and shaking bridges are the main attraction — playing in the fresh mountain air. (Adityatama et al., 2018)



Figure 7: Puncak Drajat, Indonesia (Republika Wisata Air Drajat Web, 2019)

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Ciater Hot Spring

Ciater Hot Spring is located in Lembang, a green, lush place and ciater also have nice park with small pools in which we can sit or swim. Ciater is a sub-district in Subang , West Java, Indonesia. Ciater district is the result of the expansion of jalan Cagak.



Figure 8: Ciater Hot Spring, Indonesia (Ciater Spa Conevention & Recreation Web, 2019)

This sub-district is about 26 km from the capital city of subang regency to

southwes(Ciater Spa Conevention & Recreation Web, 2019)

Current economic and social impact of geothermal tourism in Indonesia.

Kamojang, The potential for local economic growth in Kamojang is great and has many rooms for growth, with the encouragement of innovations there is no doubt that it can only make the local economy grow. (Association & Gawell, 2014)

Utami et al. (2011) proposes the development of integrated geothermal education park in Lahendong geothermal field. The concept is to create an integrated facility to give people better understanding regarding geothermal energy and its exploitation. Even though Lahendong field is already developed with operating power plant, but the concept is hypothetically possible to be applied in the green field where there is no power plant or exploration activity yet.

Infrastructure is the most important thing in the tourism industry. Without good infrastructure, it is impossible to advance our tourism sector. The government must have a commitment to improve the infrastructure and equip the necessary facilities and infrastructure. Coordination between related agencies should be improved so that the development in the tourism sector can mutually support between one region with other regions and not become a competition. In addition, security guarantees are also an important aspect in the development of tourism. For business players associated with the tourism industry, it is expected to create new products that are creative and innovative so that the world of tourism in Indonesia continues to show progress. (Ojimi, Anditya, Samuelson, Gelindon, & Lin, 2015)

Results and Discussion

Comparison of geothermal direct use in Indonesia, Iceland, NZ, Japan and USA regarding:

a. Regulation

From the table 3 about Geothermal Law that exist in several countries, it shows Japan already have laws which regulates The Geotourism in full.

b. Utilisation

From the table 2 about Direct Use Geothermal Tourism in Indonesia and Several Countries, it shows that compared with several countries, Whakarewarewa, New Zealand is the most optimum country in utilizing geothermal direct use.

c. Challenges

- The lack of adequate infrastructure in Indonesia is a persistent problem, not only because its raises logistics costs steeply thus making the investment climate less attractive but also because it limits the smoothness of traveling for tourists. Country's infrastructure is inadequate, particularly in the eastern part of Indonesia where there is a shortage of airports, ports, roads and hotels. The lack of inter and intra island connectivity means that a number of Indonesian regions that contain huge tourist potential cannot be reached easily. (Poernomo et al., 2015)

- We focus on recent government efforts and strategies that aim at attracting more foreign tourist arrivals in Indonesia, including infrastructure development, the visa-free visit entry for many nations, and specifically the geotourism

- The organization of events as well as general marketing and promotion are great tools to attract new tourists into Indonesia.

- Sharply rising investment in a previously less developed tourist area (implying there is a sudden influx of investors, workers and, later, tourists in the region) could actually give rise to social tensions among the 'native population'. It is therefore important for locals (in the targeted areas) to participate in these development programs.

Conclusion

From the discussion above, the potential advantages of utilizing geothermal resources or manifestation for geotourism objects in Indonesia, New Zealand, United States, Iceland and Japan can be conclude as:

- Transport infrastructure in this chain provides destination access to tourists from the international and domestic markets, and includes roads, airports, and railways. Social infrastructure relates to accommodation facilities in the form of rooms to accommodate tourists and other supporting physical structures for various kinds of activities and services that attract tourists. This infrastructure includes hotels, convention centers, stadiums, galleries, and other necessary facilities. Environmental infrastructure is a natural value, and refers to national parks, marine parks, and reserves which visitors can tour.

- The governments of these countries are very supportive of the existing geotourism, such as providing investment to each manager and the government also participating in promoting the places in the area to attract existing tourism so that it attracts tourists who come to the country. Increasing the number of tourists can help increase the country's economy

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- Geotourism is expected to be able to provide benefits to nature conservation, and geological phenomena that become tourist attractions, achieving tourist satisfaction through travel experiences and enriching the knowledge gained during the tour, increasing the economic welfare of the surrounding communities and achieving sustainable tourism management

Path Forward / Recommendations

- In fact, the spirit of the government in boosting the tourism sector in Indonesia has received support from businessmen in Indonesia.

- The duty of the government and society to work together to make tourist locations in the archipelago more attractive and liked by tourists. With foreign investment in Indonesia, the government's targets in tourism can be achieved, one of which is to bring in 20 million foreign tourists by 2020.

- By increasing the sector of tourism infrastructure is the supply chain of transport, social and environmental infrastructure collaborating at a regional level to create an attractive tourism destination.

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(Indonesia KayaDanau Linow Web, 2019)

(Republika Wisata Air Drajat Web, 2019)

(Ciater Spa Conevention & Recreation Web, 2019)

Tabel 1

Location	Description	Facilities (features)	Social & Economic Impact	References
New Zealand (Whakarewarewa)	Intergrated Tourism & cultural village	• Cultural performance • Nature Walks • Traditional food • Campground	• Creating 200 to 350 jobs. • Tourism spending approximately $463 million to the District economy.	• (Tourism in Rotorua: Destination Evolution and Recommendations for Management : simmons g David)
Iceland (Blue Lagoon)	Intergrated Tourism	• In-water massage, steam, sauna and other spa treatment • Skin care and clinic	• Iceland welcomes over 1.5 million tourists • Every year the growth of visitor always increase	• http://country-clone.htl-web.com/files/2016/06/HW-Thermal-Hot-Spring.pdf
Japan (Beppu Onsen)	Hot Spring	• Beppu Hell Tour • Mud bath, steam bath, sand bath • Consist of eight different springs	• total visitor numbers to hot spring destinations in Japan was 151 million people	• (Beppu International Tourist Office, 2007) • http://country-clone.htl-web.com/files/2016/06/HW-Thermal-Hot-Spring.pdf
USA (Yellowstone)	Intergrated Tourism	• National Park • Camping • Day Hiking • Wildlife watching	• Visitor spending in the recreation industries supported more than 28,000 jobs and spending in retail supported more than 20,000 jobs	• http://country-clone.htl-web.com/files/2016/06/HW-Thermal-Hot-Spring.pdf • https://www.nps.gov/yell/learn/news/18019.htm

Tabel 2

Facilities (features)	**New Zealand (Wahaka reswa-rewa)**	**Iceland (Blue lagoon)**	**Japan (Beppu)**	**USA (Yellowstone)**	**Lahendong (Danau Linow)**	**Kamojang Ecopark**	**Drajat Water Park**	**Ciater Resort & Spa**
Hot Spring	✓	✓	✓	✓	✓	✓	✓	✓
Swimming Pool	✓	✓	✓	✓			✓	✓
Cultural Performance	✓			✓	✓	✓		
Resort & Spa	✓	✓	✓		✓	✓	✓	✓
Mud Spa	✓	✓	✓					
Nature Walks	✓	✓	✓	✓	✓	✓		
Kids Playground	✓	✓	✓	✓	✓	✓	✓	✓
Wild Life Watching	✓			✓				
Outdoor Activities (Hiking, Camping, etc)	✓	✓	✓	✓	✓	✓		
Transportation/Access Road	✓	✓	✓	✓		✓		
Score	**10**	8	8	8	6	7	4	4

Tabel 3

Negara	Regulasi	Pembahasan	Keterangan
Indonesia	UU 27/2003	hak untuk melakukan bisnis panas bumi di WKP area tidak termasuk hak atas tanah. Pemegang Iup diharuskan untuk membeli tanah untuk bisnis panas bumi sesuai dengan hukum dan peraturan yang berlaku.	undang undang ini hanya untuk mengatur pemakaian tidak langsng (listrik) tidak ada yang mengatur untuk penggunan secara langsng
NewZeland	Geothermal Energy Regulation 1961	Regulasi Energi Geothermal 1961 adalah bentuk preskriptif, khas regulasi sebelum model regulasi "Robens" Dikembangkan. Fokus regulasi adalah dalam mengelola ketentuan keselamatan dan pengeboran untuk sistem bor dangkal di Taupo Zona Vulkanik. Ini terbukti dari dimasukkannya definisi "pekerjaan panas bumi" yang secara signifikan berbeda dengan artinya Pekerjaan panas bumi di bawah UU Energi Panas Bumi.	undang undang ini tidak hanya untuk mengatur geothermal saja tetapi juga mengatur untuk semua peraturan kesehatan dan keselamatan kerja
jepang	Japan Revitalization Strategy – Japan is Back' which had already been decided by the Cabinet on 14 June 2013	They will also promote regulatory and institutional reform including streamlining the procedure for environmental impact assessments (procedures usually take three to four years; hence, they are reducing the period by half) and streamlining safety regulations to promote small geothermal generation using existing hot spring wells, and promoting the understanding of local people	undang undang ini sudah mengatur tentang geoturism yang ada yaitu investasi ataupun tentnag promosi yang akan diakukan

Iceland	Act no. 73/2005 on Tourism Adiministration	The purpose of this Act is to promote the development of tourism as an economic sector and an important facet of Icelandic economic and societal activity. The guiding principles shall be economic efficiency, Icelandic culture, environmental protection, professionalism, and the safeguarding of consumer interests.	undang undang ini sudah mengatur tentang geoturism dan tata cara untuk turis secara administrasi agar mendapatkan visa secara baik dan benar
USA	The Energy Security Act of 2005 (EPAct) and The Energy Independence and Security Act of 2007 (EISA)	The Energy Policy Act (EPA) addresses energy production in the United States, including: (1) energy efficiency; (2) renewable energy; (3) oil and gas; (4) coal; (5) Tribal energy; (6) nuclear matters and security; (7) vehicles and motor fuels, including ethanol; (8) hydrogen; (9) electricity; (10) energy tax incentives; (11) hydropower and geothermal energy; and (12) climate change technology. And for the Energy Independence and Security Act of 2007 (EISA) Increased Corporate Average Fuel Economy Standards Federal Vehicle Fleets Renewable Fuel Standard Biofuels Infrastructure Carbon Capture and Sequestration	kedua undang undang tersebut mempromosikan peningkatan peran energi panas bui dalam portofolio energi nasional AS, dan keduanya memberikan insentif pajak untuk mendorong pengembangan panas bumi serta pendanaan dar Departemen energi AS (DEO) untuk berinvestasi dalam penelitian , pengembangan dan demonstrasi