GEOTHERMAL TOURISM IN NEW ZEALAND: BORROWING FROM INTERNATIONAL EXAMPLES

M.Climo[1], A Blair[2], M. Stott[1], E. Mroczek[2], S. Addison[3]

1. University of Canterbury, Private Bag 4800, Christchurch 8140, New Zealand
2. GNS Science, Wairakei Research Centre, Private Bag 2000, Taupō 3352, New Zealand.
3. Mercury, Private Bag 92008, Auckland 1142, New Zealand

melissa.climo@canterbury.ac.nz

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ABSTRACT

Geothermal energy can be utilised for electricity generation and for various other types of heat direct use applications, e.g. industrial process heating, aquaculture, agriculture and bathing. Additionally, countries and regions who have geothermal resources have a competitive advantage as a tourism destination; geothermal resources are a globally rare occurrence. New Zealand currently offers visitors geothermal experiences, predominantly through geothermal tourist parks, and spa and wellness facilities. Are there other opportunities for geothermal tourism in New Zealand that could be developed? This paper compares examples of some alternate approaches to geothermal tourism in Iceland and Yellowstone National Park (USA). New Zealand could borrow from such international examples to pair geothermal tourism more closely with outreach, education and industrial energy use.

1. INTRODUCTION

The tourism sector is important for the development of a nation's economy, with main benefits being income creation and generation of jobs. Tourism is a labour intensive sector that allows for economic diversity. It is also a fast foreign exchange earner. Tourists are attracted to outdoor areas for a range of motivations, including sightseeing, outdoor activity, curiosity, photography, collect information, education, and scientific interest. Table 1 shows a summary of the types of experiences typically offered for outdoor tourism (revised from Erfurt-Cooper and Cooper, 2010).

Table 1: Types of visitor experiences and target groups

Type of Experience	*Target*	*Characteristics*
Tours	All ages and abilities	• Largest group • Day trip or less time • Most casual about safety
Excursions/field trips	Special interest groups	• Time variable • Growing market • Moderate safety awareness
Expeditions	Experienced and fit only	• Minority group • High safety awareness • Can be extreme

Tourism NZ cites natural landscapes and scenery as the top factor for influencing visitors to choose New Zealand (Tourism NZ, 2015). A 'tourism-characteristic' industry is one where at least 25% of the industry's output is purchased by tourists (Statistics NZ, 2016). This paper will focus on tourism-characteristic opportunities.

1.1 Geothermal Tourism

Geothermal tourism, whereby tourists visit naturally occurring and/or artificial geothermal sites, is closely related to volcano tourism. It should be noted that geothermal features and environments do not need magma to occur, and can be distant from active volcanic centres; they can occur from heated ground waters rising to the surface. However, geothermal and volcanic tourism, and the visitors attracted to these environments, are often interchangeable.

These unique volcanic and geothermal environments can provide a combination of nature-based, ecological, cultural, historical, wellness/health, geological heritage, industrial and extreme (adventure) tourism experiences. Geothermal and volcanic environments attract both locals and temporary visitors, domestic and international travellers. The primary drawcard for volcanic and geothermal areas is activity. Dormant features and areas is less desirable, but may be combined with other attractions (Erfurt-Cooper and Cooper, 2010). The most popular volcanic/geothermal attractions (in order from most to least desired) are:

1. Active lava flows
2. Strombolian experience
3. Geysers and hot springs
4. Lava lake
5. Crater lake
6. Boiling ponds
7. Fumaroles and vents
8. Boiling mud pots
9. Hot rivers and streams
10. Sinter terraces

Geothermal/volcano tourism is often paired with other experiences as a marketing and visitor attraction tool. Examples include an island holiday combined with volcano exploration, such as Krakatau (Indonesia), Hawaii or Vanuatu. The Galapagos Islands offer a volcanic landscape plus unique wildlife, while Cerro Negro (Nicaragua) offers skiing on a volcano. There is also often an overlap between geothermal/volcanic environments and cultural/religious significance in many places.

There are 1300 active volcanoes worldwide, and numerous geothermal areas. Yet only a portion of these locations are practically, politically and affordably accessible to tourists.

2. NEW ZEALAND'S GEOTHERMAL TOURISM

New Zealand is located at the confluence of two tectonic plates – the Pacific and Australasian. High temperature geothermal fields (>225°C) generally have magmatic-related sources and are localised, such as in the Taupō Volcanic Zone in the central North Island. Many moderate (125 – 225°C) to low (<125°C) temperature resources are more widely

scattered and can be related to young volcanism, or non-magmatic origin related to deep faults and tectonic features.

New Zealand has a long history of international geothermal/volcanic tourism. For over 200 years Māori have welcomed visitors seeking a geothermal/volcanic experience. This legacy began with guiding visitors to experience the world famous pink and white terraces, and following the eruption of Mt Tarawera in 1886 and subsequent destruction of the terraces, the guiding legacy has continued in the Rotorua's Whakarewarewa geothermal area.

In New Zealand, tourism is worth about 5.6% of GDP and 7.5% of employment (MBIE, 2017a). Currently, it is New Zealand's number one export industry, and in 2016 contributed $34.7B to the economy; an increase of 12.2% on the 2015 financial year (Statistics NZ, 2016). In 2017, the central North Island's geothermal/volcanic region hosted 17.2% of total visitor nights in country, and 28.9% of the North Islands visitor nights (MBIE, 2017b).

New Zealand's geothermal tourism focus to date has been in three key areas: (i) spas and bathing; (ii) outdoor environments; and (iii) cultural experiences.

2.1 Health, Wellness & Spas

A close relationship between hot springs and spas with volcano/geothermal tourism is a common marketing tool, with thermal and mineral springs fitting a wellness (natural and holistic) approach to health. In New Zealand, the late 1800's saw a wave of spa development and associated tourism (Rockel, 1986). In the North Island, spas were centred on Rotorua, Taupō, Wairakei and Tokaanu (Climo et al, 2016).

Globally, modern wellness facilities and attractions took off in the late 20th century (Erfurt-Cooper and Cooper, 2009), and New Zealand continues to be involved in this market. Common offerings include baths with massage treatments and beauty, as well as medical and wellness. Water parks, aquatic centres and resorts are also being developed.

Spa and wellness is a key special interest sector in the Rotorua District. Rotorua council, Iwi and industry partners are working together on a number of Rotorua wellness tourism developments (Grow Rotorua, 2015). One key project is the Lakefront Spa complex led by Pukeroa Oruawhata Trust, whereby 11.4 ha of health and wellness facilities aims to take advantage of the geothermal resource that lays beneath it. This includes plans for a 150-200 bed, five-star hotel.

2.2 Geothermal Parks & Natural Features

Geothermal tourist parks in New Zealand offer an opportunity for visitors to explore natural geothermal environments, either guided or self-discovery. An entry fee is usually required in those geoparks containing the most spectacular active features (e.g. geysers, boiling springs and mud pots), while smaller areas of heated or steaming ground are often free to explore. The largest and most well-known geothermal tourist parks (e.g. Wai-o-tapu, Orakei Korako, Waimangu) are all protected from development.

New Zealand's large geothermal systems have been classified into management groups that direct the development allowed in/on a particular geothermal system. Types range from permitted for high capacity developments, limited capacity developments, to protected from development (Climo et al, 2016). Future ownership, governance and operational structures of some geothermal parks may change as Treaty of Waitangi claims are settled, with some natural resource assets being returned by the Crown to Māori entities. However, it is very unlikely that this will impact these classifications.

2.3 Geothermal Cultural Tourism

Geothermal can be viewed as a subgroup of geotourism, which aims to sustain or enhance the geographical character of a place, including the environment, people and culture. The principle of geotourism is that revenue should promote conservation and ensure that the attractions are available for future generations. This philosophy closely aligns with the Māori approach to development.

Māori have traditionally used hot springs for bathing and cooking since their migration to New Zealand (Stewart, 2012). Those iwi and hapu (tribes and sub-tribes) who settled in geothermally-rich areas have incorporated these unique natural features and environments into their korero (stories), whakapapa (genealogy/history), way of life and much more.

Māori legend tells that the geothermal activity in the Taupo Volcanic Zone was birthed when Ngātoroirangi, one of the early Māori explorers in New Zealand, near freezing on Mt Tongariro, summoned his sisters to bring him warmth. The sisters, aided by the atua (demi-gods) Te Pupu and Te Hoata, carried heat to the region (Stokes, 2000). Where the sisters stopped in their search for Ngatoroirangi, the warmth remained in the form of hot springs, bubbling mud pools and geysers that exist today. The surface activity of geothermal areas was recognised by Māori as a gift, a valued resource, taonga (treasure), inherited from the ancestors (Stokes, 2000).

Tourists can come to New Zealand to experience the unique Māori culture throughout the country, however it is a key strength of the central North Island that Māori culture can be combined with a geothermal experience. One example is the Whakarewarewa Village, a living Māori village (Figure 1). Visitors can watch a cultural performance, learn about traditional arts, eat a meal cooked in a hot spring, and explore the geothermal landscape and features in the valley.

Figure 1. Residents of Whakarewarewa Village live within the active geothermal area. (Photo Credit: Whakarewarewa Village).

2.4 Opportunities for New Zealand

There is a growing demand for geothermal and volcano tourism (Erfurt-Cooper and Cooper, 2010), and New Zealand is well positioned as a tourist destination. But are there other

opportunities for geothermal tourism in New Zealand that could be developed?

The next sections explore two examples of alternate approaches to geothermal tourism from Iceland and Yellowstone National Park (USA). New Zealand could borrow from such international examples to pair geothermal tourism more closely with outreach/education and industrial energy use. New Zealand also has an advantage over both Yellowstone and Iceland in its temperature climate, meaning that New Zealand's geothermal tourism season is unrestricted by climate and accessible year-round.

3. OUTREACH & EDUCATIONAL TOURISM

Interpretation is an important aspect of natural area tourism, in order to increase visitor satisfaction. Interpretation can also serve to raise awareness of environmental issues (and safety) and can aid in visitor management. Visitor services are intended to provide (Tilden, 1957):

- Interpretation based on a theme and associated messages
- Opportunity for first-hand experience and active involvement
- Maximum use of all senses
- Foster self-discovery
- Incite an emotional meaning for the visitor

The geological heritage of the region can be a valuable learning tool. Materials and tools developed to support interpretive experiences range from coffee table books to electronic phone apps. Visitor guides for walking, touring, climbing and more, can be accessed in printed, online and app formats. Factsheets and booklets are also common mechanisms for engagement, as well as discovery and interpretive visitor centres.

3.1 Yellowstone National Park

Yellowstone National Park has the world's greatest output of geothermal water (Bryan, 1986) and the largest concentration of geothermal features, estimated to be over 10,000 (Rhinehart, 1980). Yellowstone borders the states of Wyoming, Montana and Idaho and covers around 9,000 km^2. The park is situated on a high volcanic plateau (1600 – 4000 m elevation), in an area containing regional fault systems. Rock ages range from 70,000 to 2 million years old. The park is situated on a volcanic hotspot, and three caldera eruptions were the main landscape forming events.

Yellowstone was the first national park established in the USA, in 1872. Today, annual visitor numbers to the park exceed 3 million. Tourism within the park is outsourced to concessionaires (e.g. for retail, accommodation, organised tours) and this revenue is used to improve the facilities in park, including the education and outreach that the National Park Service provides.

Education and outreach is a strong component of the US National Park Service's remit, and Yellowstone is arguably the jewel in their crown. The National Park Service have staff dedicated to interpretation and education, as well as many volunteers. They offer ranger-led, self-led and online programs for teachers, families, and students of any age. Yellowstone contains 10 visitor/information centres, and most of these are interactive (Figure 2). Those centres close to geothermal/volcanic features (e.g. Old Faithful, Norris, Canyon) have a strong focus on the geothermal and/or volcanic aspects of the park. As well as regular ranger talks and displays, children are also engaged into science through junior ranger and young scientist programs (ages 5 and up, Figure 3) that set them workbooks to complete while in park.

Figure 2: An example of an interpretive display in the Old Faithful visitor centre, Yellowstone National Park.

Figure 3: Young scientists measuring a hot spring's temperature in the Old Faithful geothermal area as part of Yellowstone National Park's Young Scientist programme.

3.2 Geothermal Outreach in New Zealand

New Zealand can learn from Yellowstone in developing a depth of comprehensive educational material and delivering it in a coordinated approach. There is a significant opportunity to borrow from Yellowstone to improve New Zealand's geothermal/volcanic outreach and education. New Zealand does not have any co-ordinated educational or outreach programmes for geothermal or volcanic environments. Individual sites, particularly the commercial geothermal tourist park operations, have some local information, but it is all delivered in isolation from other sites. In this, Yellowstone has the advantage of being managed by one entity (the National Park Service), whereas New Zealand's geoparks and sites span governance by local councils, private tourism companies, Department of Conservation (DOC), Māori entities and private landowners.

However, the bulk of New Zealand's active geothermal and volcanic environments is contained in an area of around 30 km x 150 km in the central north island's Taupō Volcanic Zone. This zone is smaller and more accessible than Yellowstone, and has the advantage of being open year-round (compared to Yellowstone's Oct-May season). New Zealand's geothermally-rich zone has much greater transport infrastructure and connectedness than Yellowstone.

There is an opportunity to take a regional approach to much of the shared information on why the geothermal areas are where they are, and how they are formed. Shared resources (published, online and experiential) could be made available at multiple sites throughout the geothermal region, to supplement locally developed information (e.g. park-, site- and feature-specific).

4. INDUSTRIAL TOURISM

Industrial tourism has a focus on industrial sites peculiar to a location. It is best known through food and drinks (e.g. distilleries, wineries, chocolate factories), but also include goods that are branded (luxury), technologically demanding and innovative, and handcrafted. Industrial tourism can focus on heritage and/or modern industry.

4.1 Iceland's Industrial Geothermal Tourism

Iceland is in the unique tectonic position of being both an active hot spot and being astride the mid-Atlantic Ridge (spreading tectonic plates). Iceland has 22 active volcanoes, 250 geothermal areas and over 780 hot springs (Elfurt-Cooper and Cooper, 2010). While the island is basaltic, rhyolite and andesite volcanoes are also present. Of its 103,000 km^2, only one quarter is vegetated, while the rest is glacier lakes and lava wasteland. Around 1/3 of the worlds lava in last 1000 years has come to the surface in Iceland.

The nation currently has a thriving and rapidly growing tourism industry. Iceland welcomes over 1.5 million tourists annually, yet it has a population of only 340,000. And the number of tourists is growing significantly; since 2013 the country has experienced >20% growth year on year in visitor numbers. In 2016 it had grown by 39% on the previous year (Ferdamalastofa, 2017).

Iceland's eco-tourism focus includes wildlife, nature and outdoor adventures, the latter of which includes vast volcanic and geothermal environments. The focus of this section, however, is not on the outdoor landscapes, but rather on Iceland's industrial geothermal tourism. Iceland's geothermal development and tourism journey is different to both New Zealand and Yellowstone. Yellowstone's geothermal tourism is centralised and government structured through a national park, and New Zealand began with individual/private entrepreneurship and continues to be decentralised and independently operated (commercially and publically). Contrarily, Iceland's geothermal tourism was initially born from industrial geothermal sites and electricity companies. Iceland's five major geothermal power plants produce approximately 29% of electricity generation and 68% of the primary energy supply (Ragnarsson, 2015).

One of Iceland's most popular tourist spots is the Blue Lagoon (Figure 4), which forms part of the Svartsengi Resource Park (Gudmundsóttir et al., 2010; Albertsson and Jónsson, 2010). Soon after the Svartsengi Power Station commenced production, people suffering from psoriasis began bathing in the bluish coloured geothermal fluid in a small lagoon adjacent to the plant. Now, in addition to the baths, the Resource Park includes a dermatology clinic with research and development for treating skin disorders, an accommodation, conference and education centre, and several dedicated research and development facilities. These companies develop novel geothermal products. For example, cosmetics for skin care from microalgae and silica (Figure 5) as well as industrial geothermal research for more efficient production and utilisation of geothermal energy including for low grade heat (e.g. fish feed, aquaculture, biofuel, methanol production).

Figure 4. The blue lagoon, with the Svartsengi Power Station in the background.

Figure 5. Silica based product on sale at the blue lagoon shop, Svartsengi.

Iceland have turned their industrial use of geothermal energy into a tourist attraction, being first to market on this unique global advantage. The geothermal electricity producers have opened up their power stations to the community and tourists. For example, the Hellisheiði power plant has a public display of geothermal information, videos, plant viewing sites (including a VIP immersive experience; Figures 6, 7 and 8) and a tourism shop selling geothermal products; including a silica supplement tonic (GeoSilica) and various flavored salts made from the power station waste streams. Iceland is fortunate to have geothermal reservoir waters with < 0.1µg/kg arsenic so products derived from the geothermal water are safe for human consumption and topical use.

Iceland has turned the Svartsengi Resource Park and Hellisheiði Power Plant into a unique competitive advantage. Geothermal tourism is the focus on which to sell these geothermal by-products and services. The mentality and drive behind the concept is that the value of the geothermal resources is greater than just the high temperature electricity and heat produced. Research and development is used to unlock value in the waste fluids and gas providing multiple revenue streams and distributed financial risk.

Figure 6. The Hellisheiði power plant showing the tourist visitor centre. The backside of the power plant is used for power plant operations.

Figure 7. New Zealanders on the VIP route; in the hot water generation area of the Hellisheið power plant.

Figure 8. Hellisheið Power Plant – with viewing platform in the background.

4.2 Industrial Tourism in New Zealand

New Zealand can learn from Iceland in value-adding to existing geothermal activities, and cohesive packaging. Iceland's holistic approach to the geothermal resource has created new and different opportunities to promote tourism and enhance visitor experiences.

New Zealand has seven operating geothermal power stations, but none are regularly open to public access. Irregularly, specialist groups (e.g. delegations, conference participants) are able to tour a plant, but this is not a part of the company's business as usual activities. The closest to a publically accessible industrial site would be the Wairakei steamfield (Figure 9), which shows kilometres of pipes that carry hot fluids and steam from geothermal wells to the Wairakei power station.

Figure 9. Pipes are visible to tourists and visitors in the Wairakei Steamfield (Photo Credit: Duncan Graham, GNS Science).

New Zealand's geothermal operators may not choose to open their power stations and create visitor centres like the Iceland companies have done, however there are levels of access that might be possible through third parties. For example, through establishment of off-site information centres, printed and online material, and formalised industrial tourism packages offered by tour operators.

The geothermal industry is a part of the central North Island's destination identity, just as the natural geothermal features are. The industrial component of New Zealand's geothermal identity could be better included in the mix of geothermal packages, destinations and organised tour stops. This is an area well worth exploring.

5. RISK MANAGEMENT

Geothermal/volcanic environments can pose potential hazards to tourists and visitors. Potential hazards in geothermal/volcanic environments can include gases, such as CO_2, H_2S, SO_2, acids, such as HCl, H_2SO_4, and high temperature soils and fluids. Injuries or harm can also be exacerbated by poor communication and emergency response options due to remoteness.

In developing geothermal/volcanic tourism, safety awareness must be considered when promoting and managing these destinations (e.g. hazard mapping, signage). The parties involved can include local councils, central government, tourism entities, park services, and private companies. Coordination and consistency between these groups is essential.

6. SUMMARY

Geothermal tourism is globally rare and offers New Zealand a competitive tourism advantage, especially when combined with the other unique elements that make New Zealand a desired tourism destination (e.g. natural wilderness, Māori culture, political stability, Lord of the Rings).

While New Zealand already has a successful geothermal tourism industry, the growth of this sector and visitor experiences could be enhanced. New Zealand could better showcase our unique environments and resource uses, while also teaching a wide range of audiences about geothermal science and the natural world.

New Zealand, Iceland and Yellowstone National Park offer three different approaches to geothermal/volcanic tourism. Each geothermal industry and tourism sector had a different genesis, resulting in differences in coordination, management and focus. There are opportunities to improve educational and outreach experiences and to make greater use of industrial geothermal sites in packaging geothermal tourist experiences, by taking note of these and other international geothermal visitor experiences.

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