**Cultural factors of sustainable energy development: a case study of geothermal energy in Iceland and Japan**

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**Abstract**

Energy is important for sustainable development, yet multidimensional challenges exist for policy makers in transformations to sustainable energy systems. Sustainable development is generally recognised as having a three-lens approach: development must balance impacts in the economic, environmental and cultural dimensions. While cultural themes such as governance, motivation, and social values are widely acknowledged in the literature as critical for transformations to sustainability, however, research on these themes have been scant. Culture influences many aspects of society; hence it is important to consider culture when developing policies for sustainable development. Understanding national cultures can lead to greater understanding of what shapes national policy and strategies for transformations to sustainable energy systems. Understanding cultural influences on policy can help other countries to overcome similar challenges in policy making, planning or local resource management. Comparisons between countries serves to further advance the understanding of approaches to such challenges.This paper examines transformations towards sustainable energy through the lens of culture, through a case study of geothermal development in Iceland and Japan. Using Hoftsede’s cultural theory framework, we highlight cultural variables relevant to sustainability transformations, with particular emphasis on the challenges of the management of geothermal energy resources, and the management of related conflicts and public participation. We present our findings garnered from interviews with key players in the energy industry in both countries reinforced by an extensive literature review. We find that culture clearly influences the approach to geothermal energy development in both countries and we identify benefits and disadvantages to approaches on overlapping issues and challenges in both countries.

**Keywords: Cultural Characteristics, Sustainable Energy, Transformations to Sustainability, Geothermal Energy**

# **Introduction**

Energy is one of most critical components of sustainable socio-economic development. National and international government bodies face significant challenges in energy policy-making and transformations to sustainable energy use. Transformations to sustainability require a shift in the organization of society so that existing social patterns are re-evaluated and reconfigured -this will only be achieved by generating useful knowledge and experiences that can be applied in local settings. Therefore, a critical challenge in designing and implementing transformations to sustainable energy systems is to assemble and evaluate cases in different regions, taking into account such factors as geographical location, levels of technology, economic conditions, and cultural influences. While previous studies have examined economic, technical, and geographical factors there have been few studies examining how cultural characteristics influence transformations to sustainable energy systems (KEA European Affairs, 2006).

Cultural characteristics can be defined as socially constructed phenomena resulting in collective meanings in a shared social environment. Common cultural characteristics within a nation, including perception of identity, values, and history can be defined as embodying a national culture (Daniell, 2014; Hofstede, Hofstede, & Minkov, 2010). A deep understanding of a nation’s cultural characteristics can strengthen the overall understanding of the underlying dynamics shaping a country’s policies, governance systems, and transformation strategies for sustainable energy systems. The determination of the cultural suitability of these policies in other regional contexts may help other countries to overcome their own similar challenges.

Geothermal energy is regarded as an important component of transformations for sustainable energy systems in tectonically active countries such as Japan and Iceland; both countries have geothermal resources and many years of experience of geothermal development. Energy security is a global concern in these days of dwindling fossil reserves and growing energy demand (International Energy Agency, 2014a). In this avenue,geothermal energy has been identified by the international community as playing an important part in the transformation to sustainable energy systems. As well as having relatively low carbon emissions (IPCC, 2012), it is an indigenous resource and hence can contribute to a nation’s energy security. It is even more attractive when its low levelized cost (Matek & Gawell, 2014), high capacity factor, reliability (Shibaki & Beck, 2003) and flexibility (Matek & Schmidt, 2013) are taken into account. Research suggests that by 2050, geothermal electricity generation could supply around 3.5% of global electricity production, thus avoiding almost 800 megatonnes (Mt) of CO2 emissions per year. Furthermore, geothermal sources could contribute up to 3.9% of energy for heat by 2050 (IEA, 2011). Japan and Iceland are among the top producers of geothermal energy for heat and electricity in the world. In 2015, the USA had the highest installed capacity for geothermal electricity generation with 3450MW, with Iceland in 7th place with 665MW and Japan in 9th place with 519 MW (Bertani, 2015).

Culture, commonly seen as part of the social dimension, one of the three pillars advanced in the sustainability discourse, has received less attention in the literature and has been less clearly defined (KEA European Affairs, 2006; Murphy, 2012). According to the European Commission and Council, cultural diversity contributes to Europe’s goals for, sustainable and inclusive economic growth (KEA European Affairs, 2006). Sustainability assessments of energy technologies often fail to account for social or cultural impacts and the long-term repercussions of energy systems development. While economic and ecological sustainability assessments of energy systems are common, little social research has been carried out on the topic (Carrera & Mack, 2010). Whilst such aspects may be difficult to define, it does not mean that they are less important, or should not be measured (Dahl, 2012).

This paper focuses on the cultural dimensions of transformations to sustainability. Specifically, based on semi-structured interviews, examination of policy reports, and a comprehensive literature review this paper examines geothermal energy developments in Japan and Iceland through the lens of Hofstede’s cultural framework. Towards this end, this paper attempts to first determine the main challenges faced by policy-makers with regard to the sustainable development of geothermal energy resources and second examine the extent to which national culture or other factors shape geothermal energy policy in Japan and Iceland. This paper is organized as follows: Section 2 introduces Hofstede’s cultural framework. Section 3 provides the background of geothermal energy development in Japan and Iceland. Section 4 describes the methods used to identify challenges to sustainable geothermal energy development in both countries. Section 5 elaborates on the identified challenges and provides a discussion of cultural and other factors influencing the policy approaches to these challenges as well as recommendations. A conclusion follows in Section 6.

# **Hofstede’s Cultural Framework**

Cultural context is taken into account in Hofstede et al.'s (2010) cultural dimensions theory as a basis for comparison and understanding. Hoftstede’s framework uses six dimensions to compare cultures. These consist of power distance, individualism, masculinity, uncertainty avoidance, long-term orientation and indulgence (Hofstede et al., 2010). Hofstede's cultural dimensions theory describes the effects of a society's culture on, among other things, their decision making behaviour. This framework has been used to compare countries based on key characteristics. For instance, the theory has proven to be accurate and useful when carrying out comparisons of policies and strategies in international business (McGrath & O’Toole, 2014) and in various other sectors, such as transportation (Solmazer et al., 2016), tourism (Kang & Mastin, 2008) or health (Borg, 2014). It has also been shown to be accurate in predicting communication styles (Merkin, 2006) and the capacity to innovate (Tekin & Tekdogan, 2015) in different countries. Comparisons such as these allow greater understanding of country approaches to various issues, such as policy making, planning and local resource management.

Uncertainty Avoidance refers to the way a society deals with the unknowable future and how comfortable it feels with uncertainty and ambiguity. Countries exhibiting strong uncertainty avoidance will tend to maintain strict formal rules affecting life and decision-making and are less open to unorthodox behaviour, or new technologies (Roozmand et al., 2011), whereas those with weak uncertainty avoidance tend to have a more relaxed attitude in which practice counts more than principles.

Long-Term Orientation describes how a society manages its connection to the past while also attempting to deal with present and future challenges.  Societies with low long-term orientation are said to be “normative” in that they, prefer to maintain time-honoured traditions and norms while viewing societal change with suspicion. Cultures with high scores, have a greater tendency to prepare for the future for instance by investing in education or by saving.

Indulgence refers to the extent to which people try to control their desires and impulses. In a society with high indulgence, people have a tendency toward a relatively weak control over their impulses and such societies place a high emphasis on enjoying life and having fun, whereas in cultures of restraint, people have a relatively strong control over their urges. Such cultures will establish strict social norms in order to suppress gratification of needs.

**Power Distance** expresses the attitude of a culture towards inequalities in society. Power Distance is defined as the extent to which the less powerful members of institutions and organisations within a country expect and accept that power is distributed unequally. In societies with high power distance, people will have greater respect for superiors or elders, whereas in societies with low power distance, people will tend to take decisions more independently.

Individualism refers to the degree of interdependence a society maintains among its members and how much people are motivated by norms and duties imposed on the whole group. In Individualist societies people are expected to look after themselves and their direct family only. In Collectivist societies, people belong to groups that take care of them in exchange for loyalty.

Masculinity refers to how much societies will be driven by competition, achievement and success, with success being defined as being the best in ones field with material rewards for success. “Feminine” societies have dominant values of caring for others and quality of life. Collaboration and consensus are seen as important for decision-making. A Feminine society is one where quality of life is the sign of success and standing out from the crowd is not admirable.

# **Country Backgrounds: Culture and Geothermal Energy**

Japan and Iceland are island nations, in many ways vastly different, but sharing several common characteristics. Both are prosperous nations possessing abundant geothermal resources, many of which are within or adjacent to important national parks that draw many tourists. Japan’s current energy policy centres around providing reliable, secure, local energy which must also must be environmentally friendly, cost effective and where possible, renewable. Since the Fukushima nuclear accident in 2011, the government decided to deactivate nuclear reactors around the country and serious thought was given to the future of the country’s energy security. Japan is therefore in urgent need of new alternatives to fossil and nuclear energy since the country does not possess such resources. Iceland’s culture of independence and approach to social welfare has meant that in recent decades, energy security has been good. Indigenous energy sources like geothermal and hydropower have been harnessed to supply ample, cheap energy in relation to demand. Its main goals are to protect nature and the environment; provide societal benefits, peace and justice and economic security, stability and balanced growth ( Stýrihópur um mótun heildstæðrar orkustefnu, 2011). A National Renewable Energy Action Plan is in also in place, setting a target of 10% for the share of energy from renewable sources in transport (Ministry of Industries and Innovation, ND). Indigenous geothermal energy seems like an attractive option for both countries for increasing energy security in a sustainable manner. The current rate of geothermal development is below the potential of both countries. Table 1 shows some key statistics with regard to each country.

Table 1: Selected statistics for Iceland and Japan

|  |  |  |
| --- | --- | --- |
|  | Iceland | Japan |
| GDP PPP/Capita (Current US$) (2011-2015)\* | 52,036.7 | 36,194.4 |
| Population (millions) (2015) | 0.325 | 127 |
| Population density (people per sq. km) (2011-2015)\* | 3 | 349 |
| Electricity consumption / population (kWh/capita)  (2013)\* | |  |  | | --- | --- | | 54,799 |  | | 7,836 |
| CO2 emissions (Mt per capita) (2011-2015)\* | 5.9 | 9.3 |
| Installed generation capacity (MWe) | 665 | 525 |
| Number of geothermal power plants | 6 | 17 |
| Geothermal sources as % of total electricity supply | 29% | 0.2% |
| Estimated theoretical potential (GW) ‡ | 5.8 | 20 |
| Capacity of largest power plant (MWe) | 303 | 110 |
| Terrestrial protected areas (%) (2014)\* | 16.7% | 19.4% |
| Tourism share of GDP (%) | 6% |  |
| Ecological footprint per capita (gha) | 12.7 † | 4.17\*\* |
| Energy imports (net) as % of TPES (2011-2015)\* | 11% | 94% |
| \* World Bank, 2016  \*\* WWF, 2012  \*\*\* OECD, 2014  † Olafsson et al, 2014  ‡ Stefansson, 2005 |  |  |

Table 2 shows how each country scores for each dimension of the Hofstede cultural framework. Iceland and Japan differ significantly in terms of Masculinity, Uncertainty Avoidance and Long-term Orientation.

*Table 2: Scoring for dimensions of Hofstede framework \**

|  |  |  |
| --- | --- | --- |
|  | Iceland | Japan |
|  |  |  |
| Uncertainty Avoidance | 50 | 92 |
| Long-term Orientation | 28 | 88 |
| Indulgence | 67 | 42 |
| Power Distance | 30 | 54 |
| Individualism | 60 | 46 |
| Masculinity | 10 | 95 |
|  |  |  |
|  |  |  |

\* Scores for Japan are derived from Hofstede (2010) and scores from Iceland may be partially from Hofstede (2010) and/or may have been added through research projects of other researchers or derived from data representing similar countries (Hofstede, 2016).

## **Iceland’s economic, energy, and cultural landscape**

Iceland is a Nordic island country located between the North Atlantic and the Arctic Ocean with a population of approximately 325,000 people (Statistics Iceland, 2014). The majority of Iceland’s population lives in the capital city of Reykjavík and its outlying towns while the other parts of the island are sparsely populated. In 2015, 81% of Iceland’s total primary energy supply is derived from domestic renewable energy sources, the remainder consisting mainly of imported oil fuel for the transportation sector (National Energy Authority, 2015). Iceland is a hotspot of volcanic activity, sitting on top of the Mid-Atlantic ridge, and one of the most tectonically active places on earth. Currently, Iceland has 6 operating power plants and the installed geothermal electricity generating capacity stands at 665 MWe (National Energy Authority, 2015) and geothermal plants are located mainly in the south-west or far north of the country. Figure 1 displays a map of Icelands’ geothermal plants and their generation capacity in 2015. Since the 1950s, Iceland has made the transition from being heavily dependent on fossil fuels to producing most its energy from domestic, renewable resources.

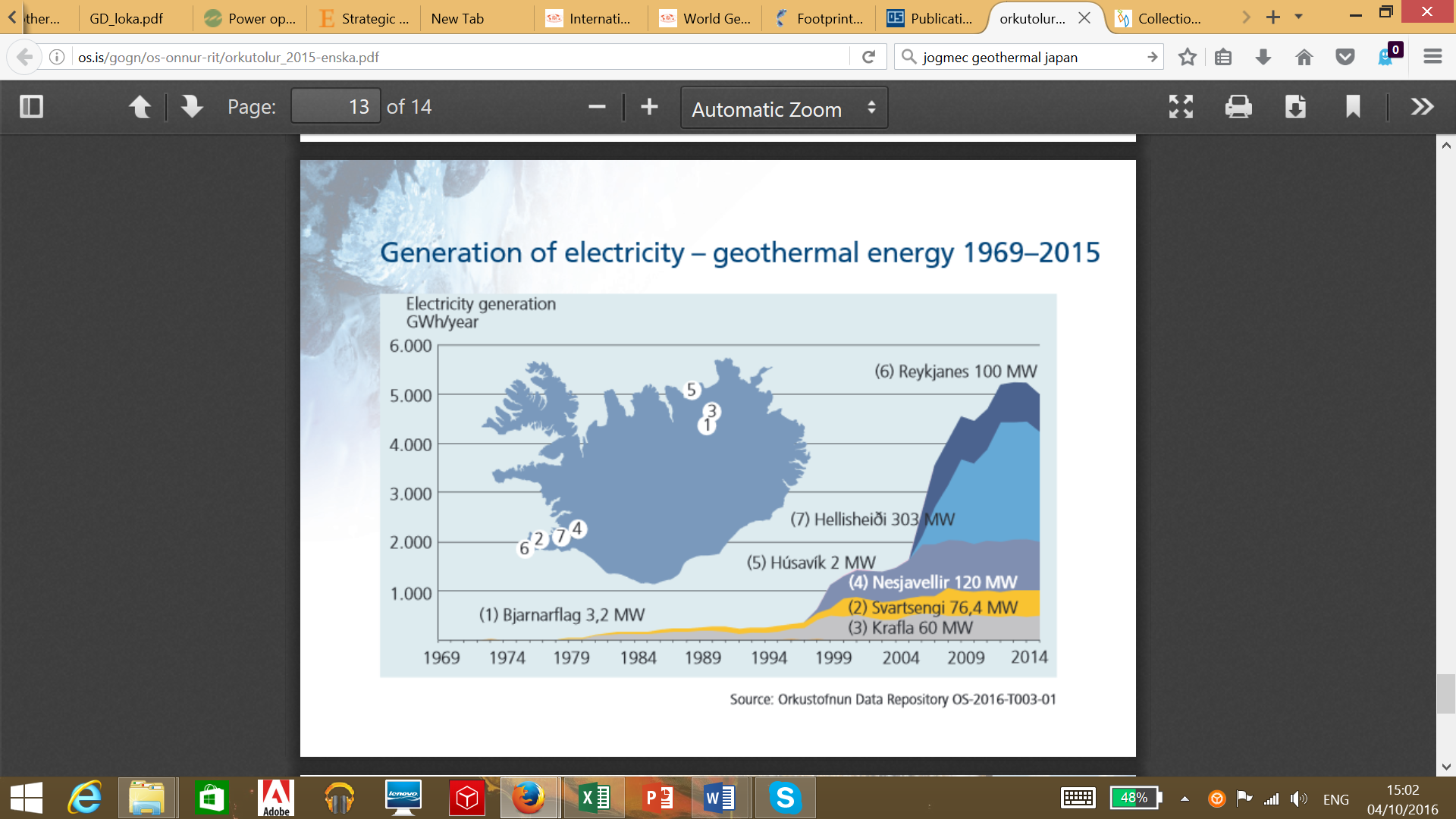
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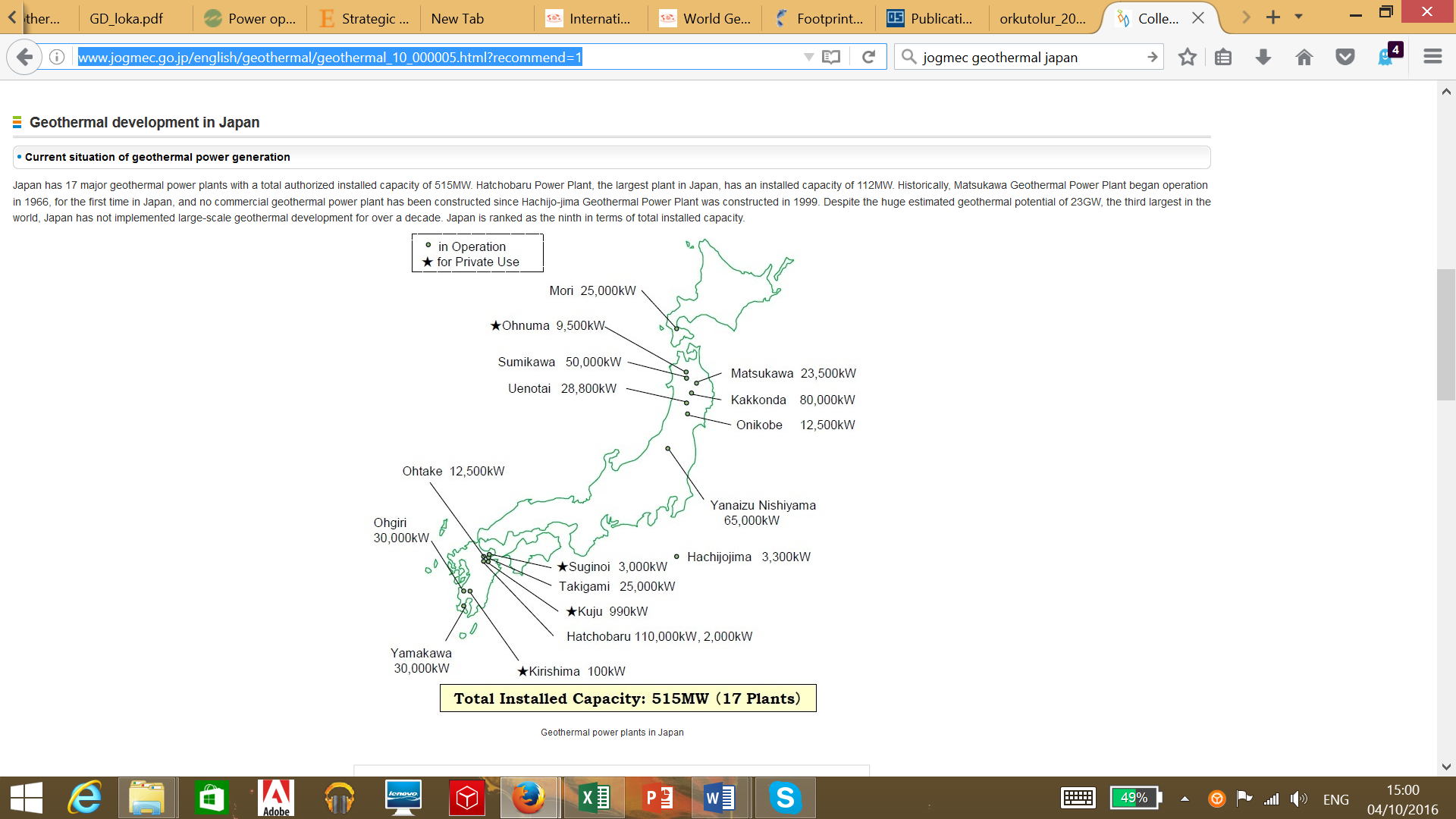
Figure 1: Map of Iceland's geothermal energy plants and their production capacities 1969-2015 (National Energy Authority, 2015)

Geothermal energy in Iceland is used for the most part in space heating or electricity generation, with the remainder being used in such applications as swimming pools, snow melting, fish farming, greenhouses and other industries such as for tourism. In 2015 around 70% of gross energy consumption was from geothermal sources, with the largest proportion used for space heating, and in total around 87% of gross energy was produced domestically (National Energy Authority, 2015). Increases in geothermal electricity generation are very likely in coming years and new developments are planned, beginning in the north (Ragnarsson, 2015). Tourism, a growing industry in Iceland, will also contribute to the development of geothermal development.

Iceland, according to the Hofstede’s (2010) research and online country comparison tool (Hofstede, 2016) is a country with low power distance score (30), implying that communication is information, direct and participative and hierarchies are relatively flat, with reciprocal sharing of information between superiors and staff. Iceland has a high individualism score (60) which implies that people do not identify with a group but tend to take care of themselves and immediate family. Iceland also has a low masculinity score (10) making it a distinctly feminine society, in which, the focus is on cooperation, consensus, equity, and quality of life. Iceland has a moderate score for uncertainly avoidance (50) implying that the society tends to focus on flexible planning but also have a relatively relaxed attitude to risk and trying out new innovations. Iceland has a low long-term orientation score (28), which implies that it has a normative culture. Meaning there is great respect for traditions, a relatively small propensity to save for the future, and a focus on achieving quick results. Iceland is also classified as an “Indulgent” country, which implies that society has a relaxed attitude towards fulfilling personal desires.

## **Japan’s economic and energy landscape**

Japan is a country in East Asia with a population in 2016 was 127 million (Principal Global Indicators, 2016). While Japan has an advanced and diversified economy, it has few indigenous energy resources. Currently, the country must import 84% of its primary energy requirements, mainly in the form of oil and natural gas imports (World Nuclear Association, 2016). Nuclear energy provided 14% of Japan’s total primary energy supply (TPES) in 2008 and this reduced to 1% in 2013 (International Energy Agency, 2014b)*.* The share of natural gas in the country’s TPES increased from 17% in 2010 to 23% in 2012, because of growing demand from the electricity generation sector (International Energy Agency, 2014a). Japan, like Iceland, is one of the world’s most tectonically active countries, located along the Circum-Pacific Volcanic Belt, or “Ring of Fire, with nearly 200 volcanoes and hence abundant geothermal energy resources. Most geothermal power plants are located in the Tohoku and Kyushu districts. The first experimental geothermal power generation in Japan took place in 1925 at Beppu, Oita Prefecture, in southern Japan. The country’s first commercial geothermal power plant was opened in 1966 at Matsukawa and the world oil crises of the 70s increased the demand for alternative energy such as geothermal (Kawazoe and Combs, 2003). Japan has 17 major geothermal power plants with a total authorized installed capacity of 525 MW (JOGMEC, 2016).



*Figure X: Map of Japan’s geothermal energy plants and their production capacities (JOGMEC, 2016)*

Apart from electricity generation, the direct use of geothermal resources is estimated at around 2100 MWt, the majority being attributable to bathing (87%) and other applications such as space heating (4%), snow melting and greenhouses (Yasukawa & Sasada, 2015). Geothermal contributes around 0.2% to the national power supply. The estimated theoretical potential of geothermal energy in Japan to a depth of 3 km is 20 GWe or larger. However, eighty percent of geothermal potential in Japan exists inside national parks, which has made it difficult to develop these resources (Yasukawa & Sasada, 2015). No new geothermal power plants have been opened for more than a decade, but exploration and development has increased in recent years, since the nuclear accident at Fukushima of 2011.

Japan, according to the Hofstede et al’s (2010) research, is a country with a moderate power distance score (54), implying that it is quite hierarchical in that there are many layers of management, but this is tempered by an emphasis on gaining consensus in decision-making from all levels. Japan has a moderate to low individualism score (46) which implies that people are loyal to a larger group but that groups may be competitive with each other. Japan also has a very high masculinity score (95) making it a distinctly masculine society, in which the focus is likely to be on competition and a drive for excellence. Japan is said to be one of the must uncertainty avoiding countries in the world with a score of 92, implying that the society tends to focus on predictability in procedures and painstaking planning and risk assessment. Japan also has a very high long-term orientation score (88), which means that much thought is given to investing for the future and future generations, e.g. through R&D and on long-term performance. Japan has a culture of “restraint” in that it scores low (42) in terms of indulgence, which would imply that people do not place high emphasis on leisure time or gratification of desires.

# **Data Collection Methods**

This research has been informed by a comprehensive literature review and key informant interviews with researchers, industry practitioners, and policy makers in geothermal energy development in Iceland and Japan. The collected data was then triangulated, whenever possible, for purposes of validity (Patton, 2002). The literature review included industry reports, technology assessment documents, governmental publications, and academic publications relevant to geothermal energy. The literature review was undertaken to establish what is known about the key challenges, opportunities, and uncertainties in geothermal energy development.

The interviews methods included structured and semi-structured questions through in person interviews and e-mails with key actors involved in geothermal energy development. This study is based on eight semi-structured interviews, each approximately one to two hours long, which were conducted between April and July 2016 with decision-makers and experts from Iceland and Japan. As well as this, two email interviews were carried out in cases where travel was not possible. The Icelandic interviewees included executives from a geothermal power company, the National Energy Authority in Iceland, Iceland geosurvey (ISOR), the planning authority and the energy master plan (Rammaaaetlun) committee. The Japanese interviewees included executives from the Ministry of Economy, Trade and Industry (METI) and Japan Oil, Gas and Metals National Corporation (JOGMEC), an energy journalist (Kyodo News) and an academic specialised in geothermal energy. Officials from the Icelandic embassy in Japan, with knowledge of the geothermal sector in both countries, were also interviewed. All responses are taken to be the interviewee’s personal view and not the view of the organization.

At the time of the interviews, the experts were affiliated with authoritative scientific institutes involved in geothermal power development or other organisations with an interest in geothermal power. The topics of the interviews covered challenges to sustainable energy development, challenges for geothermal energy development in particular, possible cultural influences on energy development, public opinion on geothermal energy, public participation in energy decision-making.

# **Influence of Cultural Characteristics on Geothermal Energy Development**

Challenges to sustainable energy transformations centre on providing access, particularly in least developed countries, increasing energy efficiency, environmental impact, social acceptability, and security. The extent and particulars of these challenges will depend on the unique socio-economic, environmental, and mix of energy sources of a country. Specific to Japan and Iceland, the development of geothermal energy has increasingly been viewed with strategic interest by policy makers. Geothermal energy is of particular interest in this regard due to its base-load capabilities, low operating cost, the fact that it is indigenous and produces relatively low greenhouse gas emissions. Geothermal is also multi-purpose in that it can be used to produce hot water for a variety of direct uses as well as electricity. However, geothermal projects have the disadvantage of long development times and high up front cost. In Iceland geothermal energy has been the most widely used renewable energy source for both electricity and district heating purposes while in Japan this energy source has high growth potential in the coming decades and is important for increased energy independence, reducing nuclear energy usage and reducing carbon emissions. Within the overall scheme of sustainable energy transformations however, geothermal energy has its own distinct challenges and idiosyncrasies.

While previous studies have examined the technical, economic, and environmental dimensions of geothermal energy development, this study examines the transformation to sustainable energy systems through the cultural dimension. Specifically, we examine how national cultural characteristics influence geothermal energy development. Firstly, the management of geothermal natural resources with its associated technical and environmental challenges; secondly, the social aspects of geothermal development, including managing conflicting interest between energy developers, environmental conservationists, and spa and onsen business owners; and the width and depth of public participation. Cultural characteristics influence how each country approaches each of the above challenges. In this section, we discuss the unique approaches to resource management, conflict management and public participation in Iceland and Japan through Hofstede’s cultural framework.

## **Management of geothermal natural resources**

A geothermal resource’s lifetime refers to the length of time that a geothermal resource can continue to be exploited to commercially produce electricity at a given capacity that ensures its economic viability. Since geothermal energy is generally regarded as a renewable, the availability of geothermal resources should be ensured for future generations, which means that their replenishment should occur on timescales acceptable to human societies. Premature depletion of geothermal resources therefore poses a sustainability and energy security challenge. Within this theme, the cultural dimensions that influence the management of geothermal natural resources include Uncertainty Avoidance, Long-term orientation and Indulgence.

In Iceland, an acceptable lifetime of 100-300 years has been proposed for geothermal resources, although this has not been incorporated into legislation. The question of the ideal geothermal resource lifetime is a complex one and acceptable timeframes will depend on the society’s and hence policy-makers’ definitions of sustainable utilization. Icelandic experts have identified various strategies for sustaining the yield of geothermal resources. Within each strategy the resource utilization periods and rest periods differ (Axelsson, 2013). Nonetheless, the management of geothermal resources in Iceland has come under scrutiny in recent years following the discovery that some resources were becoming depleted much faster than anticipated. This was due to the implementation of management practices that did not aim to maximise the longevity of the resource. Interviewees maintain that management challenges still exist in ensuring a sustained yield from geothermal resources.

Icelandic legislation requires that the most efficient exploitation of natural resources occurs and that extraction of geothermal fluid should not exceed “levels deemed necessary” (Ketilsson, Olafsson, Steinsdottir, & Axelsson, 2010). For a single geothermal resource, the Icelandic authorities recommend restricting the exploitation of the resource to as few operators as possible. Underground resource management has not been as pressing a concern in Iceland compared to in Japan because the geothermal fluid not extracted by so many different users. However, the sustained yield of energy in the case of larger plants is still a concern.

It is commonly recommended that geothermal resources are gradually developed in steps, so that the resource capacity and behaviour can be determined, otherwise the developer risks prematurely depleting the resource to levels where the initial rate of production cannot be maintained, which can result in difficulties in meeting energy demands. Such has been the case at the Hellisheiði plant (Gunnarsson et al., 2011), the largest geothermal combined heat and power plant in Iceland. Once a geothermal resource has been depleted, it may take decades or centuries to replenish the natural energy flow (O’Sullivan et al., 2010; Pritchett, 1998), which means that the sustained yield of the resource may become compromised.

Iceland scores 50 for Uncertainty Avoidance, which suggests that while planning is carried out, there is also room for improvisation. In general, Iceland has approached geothermal energy development with a willingness to innovate and take some risks. As a result, Iceland possesses a great deal of expert knowledge on geothermal development. On the other hand, a less risk-averse approach may lead to a lack of foresight regarding the future, as shown by the Hellisheiði case. Reflecting this, Iceland scores 28 for Long-term orientation, which is quite low. This implies a normative culture whereby there is a tendency to look for quick results. Iceland is also shown to be a fairly indulgent culture with a score of 67 on this dimension. This implies that there is a tendency toward optimism and the fulfilment of desires. The country has made very good use of geothermal energy to create comfortable living conditions for the population, with an emphasis on abundance of heat and energy at low prices. While an unreasonable waste of energy cannot be said to occur, the use of energy in Iceland should not be described as frugal. Perhaps this is due to the small population and a general feeling of abundance of energy as a result. As geothermal energy may be exhausted in the long term, however, tightening building energy efficiency requirements has been recommended, as well as removing subsidies for electric and oil heating for the 10% of the population that does not have access to geothermal heat (OECD, 2014).

Japanese management practices for geothermal plants have, until now, erred on the side of caution. In comparison to Iceland, geothermal projects in Japan tend to be smaller and observed for a longer period of time before expanding their capacity. Most of Japan’s geothermal resources are located in mountainous regions without power transmission lines or good roads, which increase the cost of drilling and hence financial risk for developers. Current risk control strategies for the protection of hot springs near power plants include changing project plans or implementing risk mitigation plans which involve regular hot spring monitoring. Hot spring owners and developers may share monitoring data with each other or with local governments, although data collection may be too costly for some. No uniform guidelines for assessing the impact of power generation exist, due to the wide variation in geothermal resource characteristics and the lack of baseline data available on hot spring conditions (Kubota et al., 2013).

Japan scores 92, which is extremely high, for Uncertainty Avoidance, which suggests that for geothermal development, they will wish to eliminate as many uncertainties as possible. The developer and authorities will not act without precedence, and as a result, it can take 15-20 years to move from the planning phase to the operation phase (Kubota et al., 2013). A guideline for geothermal drilling licenses has been introduced by the Ministry of the Environment in 2013, which aims to shorten the period for obtaining drilling permission from prefecture governments and aid discussions with local residents, especially onsen owners, who may be opposed to geothermal development (Yasukawa & Sasada, 2015). Opponents of geothermal development in Japan, concerned about the risks and uncertain future impacts that developing the underground resources will have on hot springs, have also called for better preparedness for unexpected problems such as having continuous monitoring of hot springs and accident compensation insurance for development (Kubota et al., 2013)*.*  Government mid- to long-term policies are aiming to reduce investment risk, establish transmission lines and pursue development acceptable to local communities. The Ministry of Economy, Trade and Industry (METI) approved and announced a “Long-term Energy Supply and Demand Outlook” in 2015, pursuant to the policies of the Strategic Energy Plan, which states that geothermal energy would be increased from 0.3% of primary energy to 1.0-1.1% of primary energy by 2030 (Ministry of Economy, Trade and Industry, 2014). While the government has envisioned more momentum in developing geothermal energy, interviewees remained understandably sceptical that faster progress would be made.

Japan scores 88 for Long-term orientation, which is a very high score. This would suggest that for geothermal development, the Japanese will put an emphasis on thoroughly researching the resources and ensuring that they remain for future generations, while at the same time attempting to ensure that other users such as onsen owners are not adversely affected. Japan is also shown to be a less indulgent culture with a score of 42. As a restrained society, a tendency not to indulge immediate desires is the norm. In this way, the Japanese can be said to have an intergenerational outlook. Some good examples of geothermal plants with long lifespans exist in Japan. Managers put this down to a cautious approach and the practice of researching the resource carefully before increasing production capacity of plants (Hanano, 2003).

## **Management of conflicts and public participation**

Geothermal resources have multiple potential uses and users. This can cause conflict among various users of the resource as well as impacted sectors. Conflict management between groups will determine the smooth passage of geothermal projects. Conflict may occur between geothermal development and conservation areas, the tourism and recreation sectors or cultural practices. Energy developers wish to tap into underground geothermal resources in order to generate electricity from the high temperature fluids they supply. This involves carrying out exploration, drilling and construction activities on the lands above the resources. Areas are designated for conservation when they contain important ecological resources, areas of unique natural beauty or cultural significance. In such areas it may not be permitted to build structures or carry out certain activities that might interfere with the ecology or landscape. In turn, sectors that rely on areas of unspoilt beauty or cultural significance may be impacted. The cultural dimensions that may influence conflict management and public participation around geothermal energy development include Power-Distance, Individualism and Masculinity.

Icelandic society has always had strong ties to the natural environment through fishing farming and cultural beliefs around landscapes (Schaller, Jónasson, & Aikoh, 2013) and about 20% of the land area of Iceland is under some form of nature protection scheme, among the highest shares in the OECD. Nonetheless activities like tourism and energy development exert pressure on Iceland’s biodiversity: more than 290 species of flora and fauna are threatened, including nearly 40% of the bird species nesting in Iceland and 12% of the country’s moss species. (OECD, 2014). In Iceland, geothermal resources may be located beneath or next to national park zones. The Icelandic landscape is characterised by a lack of trees or vegetation, meaning that breath-taking views are unobstructed for many kilometres in all directions. Geothermal plants have a visual impact on the landscape through the building of structures and visible pipelines and emitting plumes of steam. Particular concerns have therefore arisen among the public (Benediktsson, 2007) and experts (Thórhallsdóttir, 2007) regarding the impact of geothermal energy development on geology and hydrology, unique landscapes and wilderness, given the unspoilt nature of the countryside and its value to tourism.

Iceland scores 30 for Power Distance, which is quite low. This would suggest that decision-making hierarchies are flatter, with informal, direct and participative communication. Icelandicinterviewees acknowledged that public participation was essential to gaining public acceptance for geothermal projects, as well as for improving the entire development process. However, the interpretation of the meaning of public participation differed widely. Some interviewees believed that governments should have the final say in the choice of energy projects whereas others believed that the public should be involved to a much greater extent in the choice and design of energy projects. With an extremely low score of 10, Iceland is considered a definitively Feminine society. This would suggest that consensus is sought after in decision-making that conflicts would be resolved by compromise and negotiation and that well-being is more important than social status.

In Iceland, a process to draw up a master plan was started in 1999 in order to make decisions on where to develop geothermal resources and this takes into account protected areas. The current energy master plan, known as “Rammaaetlun”, is now in its third phase of analysis and involves ranking energy projects using multiple criteria. The master plan identifies eighty different development options for hydropower and geothermal power plants. The options have been listed and analyzed by expert groups, taking into account impact on nature, impact on economic sectors such as tourism and agriculture and socio-economic impact, as well as cost effectiveness of each option. The sites have been categorized as either acceptable for development, subject to further research or protected. The master plan has been accepted by the Icelandic Parliament and is currently in its third phase of analysis (Rammaaaetlun, 2016). All municipalities must incorporate its provisions in their land-use plans. The master plan was subject to input from various stakeholders over a number of years, however, a small expert group is ultimately responsible for the rankings. Until recently, the social impacts of energy developments was not informed by qualitative data from the general public and as such, this remains limited. Comments and concerns from stakeholders have, however, been sought and considered (Rammaaaetlun, 2016), although a deliberative process was not used with members of the public (Thórhallsdóttir, 2007). Energy projects in Iceland are subject to environmental impact assessment (EIA) and EIA law calls for public involvement at various stages of the process, however, criticisms of this system in the past have related to the lack of regulation regarding requirements for public participation in EIA, adequately informing the public on environmental issues and their right to participate and the fact that EIA is not a decision-making tool in itself but a means of gathering information (Ogmundarson, 2009).

Iceland scores 60 for Individualism, which implies that people will identify less with a group and more as individuals. Society is therefore loosely knit, which may have an impact on the cohesiveness of collective decision-making. Although the society has feminine characteristics such as consensus seeking, the high individualism means that nationally it may be more difficult to reach consensus, for instance when vested business interests come into play (Benediktsson, 2007). Despite Iceland’s small population, national level political interests may clash with community interests and cultural traditions (Ogmundardottir, 2011). This is echoed by the differing views of decision-makers interviewed, regarding how much the general public should be involved in national energy decision making. It may also explain why the master planning is inclusive to a point, but lacks deliberative mechanisms for the greater general public.

Both foreign and Icelandic tourists are drawn to geothermal bathing areas for their relaxation and health benefits. In 2014, the most paid for domestic recreational trips taken by Icelanders were trips to spas and nature baths (Icelandic Tourist Board, 2015)). In Iceland, conflicts with geothermal energy and natural hot spring usage are uncommon, since open air hot springs are not generally exploited for profit and may be located far away from settlements. Around the island, people continue to bathe in natural hot rivers or springs, but larger scale man-made bathing facilities using geothermally heated water are more common and are found in most settlements around the country. These man-made swimming pools, often also have steam baths or saunas and are a popular location for socialising, especially during the winter months. Historically, the hot pools in Laugarnes (Reykjavik) were used for swimming and clothes washing and this is now the site of the main swimming pool of Reykjavik. The Blue Lagoon spa offers an example of a win-win situation of using geothermal resources for energy and wellness tourism. The spa is located in a peaceful, natural setting in the lava fields of Reykjanes and is popular for foreigners and locals alike. The spa is also popular for psoriasis treatments. Health spas like Blue Lagoon usually make use of waste water from previously built power plants, whereas natural hot springs are not exploited widely by the tourism sector.

Japanese society can be said to have a strong spiritual and emotional connection to the natural environment (*shizen*) rooted in both Buddhism and Shintoism (Thomas, 2001). Around 80% of Japan’s most promising geothermal fields for development are located in its national parks and may be close to hot springs used for bathing and recreation. Many Japanese national parks are rich in geothermal manifestations, such as the Goshogake Hot Springs at Mount Hachimantai. National parks are classified into zones, but the system is unique in that land is not "set aside" for nature conservation, but only classified as national park wherever the need to preserve "scenic beauty" has been recognized, regardless of land ownership or land use (Hiwasaki, 2005). This implies that various stakeholders would need to be consulted and reach a consensus in national park management. Strict laws exist to protect national parks in Japan and up until recently, no geothermal development was permitted. The Ministry for the Environment has now relaxed rules regarding geothermal development, which was limited in Japanese national parks to 6 sites, as per the 1974 National Park Act regulations. As of 2012, the Ministry of Environment (MOE) deregulated development in national parks on certain conditions, allowing small scale (< 3MW) developments in Class II and III zones, but not in Class I and special protected zones. In 2015, slant drilling from outside of Class I special zones was conditionally accepted (JOGMEC, 2016). Interviewees acknowledged that this change in laws was not likely to lead to large scale geothermal development in protected areas, but could lead to innovations in non-invasive exploration technologies smaller scale plants. For instance, JOGMEC conducts heli-borne geophysical surveys to gather basic data on geothermal resources using technologies such as airborne gravity gradiometry (AGG) which allows them to survey national parks.

In Japan, millions of tourists stay at onsen resorts each year and the Ministry of the Environment recognises onsen as a medical therapy. Given the popularity of onsen resorts, hot spring usage is governed in Japan by the 1948 Hot Spring Law, which defines characteristics and health and safety requirements of hot springs. The law defines natural springs containing a defined amount of chemicals, or having a temperature of over 25C as onsen. (Serbulea & Payyappallimana, 2012). Japan attains a high score of 95 for Masculinity, making it one of the most Masculine societies in the world. Since they also score 46 for Individualism, this would suggest that quite severe competition exists between different groups which serves as a motivation in business to outperform the competition. Opposition to the development of geothermal resources for electricity has been strong from hot spring owners and local governments. They fear that depletion of geothermal resources may cause the extinction of major geysers and hot springs, causing irreversible damage. If this happens, these groups stand to lose substantial revenues from onsen tourism and have exerted their influence on the decisions of local governments regarding the issuance of drilling permits (Kubota et al., 2013).

Japan achieves a score of 54 for Power Distance, making it a slightly hierarchical society. Its slow decision-making process has been moreso attributed to the need for consensus between levels rather than things being decided from the top down. Nemawashi is a semi-formal but systematic and sequential consensus building procedure in Japan by which the approval of a proposed idea or project is sought from every person in a significant organizational position. This would suggest that in order to gain acceptance for geothermal projects, each concerned group must feel like they have been included in decision-making. Historically, the Japanese legal systems for public participation in decision-making have tended towards voluntary rather than rights-based approaches. Developments since the Rio Declaration mean that now around 30% of local government in Japan have a legal framework for public participation, since the Aarhus Convention, however, participation levels vary between regions. Power projects are subject to EIA law in Japan and the EIA process, during which the public may submit their opinions. The nature or timing of the participation has been criticised, however and has been said to lead to conflicts. The government has stated public participation in EIA is not intended to guarantee any procedural right and is only a means to collect information on environmental concerns in order to make better decisions. Following the great earthquake and Fukushima accident of 2011, the government was forced to revise and enact more than 40 laws (Okubo, 2016). Innovations in public participation were required and following the accident, the government undertook a “National Discussion” on energy policy. This was the first time deliberative polling was used in Japan on the policy level in which 285 randomly selected participants deliberated on nuclear policy options with the assistance of a panel of eight specially selected experts. The government reformulated nuclear policy based on the outcome of the National Discussion, however, the policy decision was abandoned following a change in government (Mikami, 2015).

METI believe that building a greater understanding of geothermal energy development will aid in the acceptance of new power plants by opponents and the general public. Most Japanese residents are familiar with onsen, but few are knowledgeable about geothermal power generation (Kubota et al., 2013). Under the Act on Purchase of Renewable Energy Sourced Electricity, METI has allotted a budget for public acceptance activities, where they provide 100% subsidies for public acceptance cost to developers (budget Y2.8billion) (JOGMEC, 2016). The tradition of onsen is dwindling in Japan due to lifestyle changes and increased movement towards urban centres. As long as no adverse effects are observed or predicted, geothermal power developments could be used to help to revive such traditions by working with onsen owners who may also be interested in profiting from small scale generation, building consensus and helping develop geothermal tourism in less populated areas and to generate other income sources.

# **Conclusion**

By understanding the cultural dimension of a nation or region, researchers and policy makers can better situate challenges of risk, planning, innovation, and stakeholder engagement in decision making. Using Japan and Iceland as case-studies, this paper identifies challenges to sustainable energy transformations in both countries and applies Hoftsede's cultural framework to highlight the cultural variables relevant to these transformations. The themes of geothermal resource management, conflict management, (be it between energy developers, environmental conservationists, or spa and onsen business owners); and the width and depth of public stakeholder engagement were common challenges in both countries. Based on their cultural characteristics, each country has its own unique approach to these challenges.

Given their particular cultural values on the Uncertainty Avoidance, Long-term Orientation, and Indulgence variables, the development of geothermal resources between Japan and Iceland are strikingly different. Iceland has been able to better develop its geothermal energy resource capacities while Japan has been more risk averse and slower. The population of Iceland is only 0.25% of Japan’s yet Iceland has more installed generation capacity from geothermal sources. Iceland has more appetite for risk while Japan does not, which means that Iceland’s approach may lead to unintended consequences, but at the same time it may foster more innovation based on learning from past mistakes and the fulfilment of its geothermal energy capacity. Japan on the other hand has been slower in leveraging its geothermal capacity, most critically after the Fukushima calamity, to diversify and progress towards more sustainable energy resources. Although Japan’s geothermal development has been slow, it may however in the long run benefit more from the late adoption of tested and perfected technologies.

Interestingly, despite having different scores for the variables of Power Distance, Individualism, and Masculinity, which impacts how each country engages in public participation and conflict management of geothermal developments, the two countries face similar challenges. In both countries, criticisms have been made on the level of public participation in EIA, which has been described as a means of gathering information rather than a decision-making tool that involves the public. Japan has however made progress with deliberative energy policy making in the aftermath of the Fukushima disaster with some success. Iceland has also come up with possible conflict avoiding solutions through industrial symbiosis between geothermal plants and wellness tourism. Given the opposition of onsen owners to geothermal development in Japan due to fears of resource depletion, this is a tactic that could also be used by Japan in the future, if geothermal energy is to be expanded in popular onsen areas. Regardless of the type of conflict, it appears that more inclusion of the public in decision-making would be beneficial in both countries. For Japan in particular, the education of the onsen owners and enthusiasts on the degree of impact of geothermal power plants on hot springs could be a worthwhile exercise, since this topic is not so widely studied or understood.

Although its scoring system serves only for comparative purposes, using Hofstede’s cultural framework is extremely useful to compare approaches in geothermal energy development between countries. A transformation to sustainable energy systems necessitates the examination of the environmental, economic, and cultural dimensions. In this avenue, it is crucial to take cultural dimensions into consideration in the design and diffusion of renewables. This paper demonstrated the importance of the unique cultural approaches to the development of geothermal energy in Japan and Iceland. It is hoped that this paper inspires more research in this area and contributes to the broader global community in achieving transformations to sustainable energy systems.

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