The Arctic Tomato
The diverse uses of geothermal water in Iceland

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Abstract

This work discusses the impact changes in geothermal utilization have had on both food production and consumption. Access to abundant geothermal water, clean air and the use of state of the art technology becomes a question of preferences rather than technological or economic limitations. Radical innovations such as LED lightning and more ecological cultivation techniques make it possible to grow local produce that can compete with imports, tomatoes, cucumbers, even strawberries in dark winter nights. Here the inexpensive access to the geothermal resource is imperative. Even the "pizza generation" is moving towards lighter and healthier fare: fresh fish, greens all year round, locally grown tomatoes, capsicum, even eggplants are becoming more Icelandic than the Nordic fare. Icelandic/Mediterranean Cuisine is a more appropriate term than the New Nordic Cuisine which has become recognized worldwide.

Key words: Arctic, tomato, geothermal water, Iceland

This study discusses the impact changes in geothermal utilization have had on both food production and consumption. It has more to do with scale than scope. Access to abundant geothermal water, clean air and the use of state of the art technology is becoming more a question of preferences rather than technological or economic limitations. Radical innovations such as LED lightning and more ecological cultivation techniques make it possible to grow local produce that can compete with imports, tomatoes, cucumbers, even strawberries in dark winter nights. Iceland's rapidly increasing capabilities and skills in product development go hand-in-hand with the rising popularity of organic food. Here the inexpensive access to the geothermal resource is imperative. Even the

"pizza generation" is moving towards lighter and healthier fare: fresh fish, greens all year round, locally grown tomatoes, capsicum, even eggplants are becoming more Icelandic than the Nordic fare. Icelandic/Mediterranean Cuisine is a more appropriate term than the New Nordic Cuisine which has become recognized worldwide.

The energy crises in the beginning of the 70s turned the worries of a relatively few environmentalists, about the depletion of resources and the limits of growth, into a widespread fear of energy shortages. The search for alternative energy sources, preferably renewable, became a global task. In Iceland the possibilities of the utilization of geothermal power was close at hand. Oil accounted for 53% of space heating in Iceland in 1970; the ratio dropped to less than 5% in 1985 and 1% in 2010, with 10% coming from hydropower, the remainder from geothermal water.

The use of geothermal energy in Iceland has developed in sync with time, as what was once a cumbersome necessity has become an economically and technologically feasible alternative to imported fossil-based energy sources. The importance of geothermal water as an energy source is to be found in its particular physiological properties and direct use, instead of a source of generic energy, as is the case of electrification.

The rapid and successful shift from large-scale hydroelectric plants constructed to supply energy-intensive industries was primarily due to long range planning aimed at industrializing the economy which was temporarily halted due to worldwide oversupply of inexpensive energy.

The following study is an analytical overview of the impact of the "geothermal" on the everyday life of Icelanders (Jónsson 2009). Initially as an alternative to imported oil and coal, which were too costly for widespread use, geothermal power has become one of the country's most important assets, providing inexpensive space heating, facilitating locally grown vegetables and flowers all year round, and even making the outdoor swimming pool the most frequented gathering place nationwide.

Going green

In a renowned report, Joseph E. Stiglitz, Amartya Sen and Jean-Paul Fitoussi (2009) emphasize the importance of measuring economic performance and social progress in a holistic manner, by entwining indicators of "quality of life" and sustainable development and environment. Furthermore, they emphasize the importance of taking

subjective or qualitative measurements alongside the more quantitative indicators which have been dominant for decades, taking for granted that further economic growth is a precondition for increased wellness.

Today it is, to an extent, important to shift the emphasis from measuring economic production to measuring people's well-being. Wellness or healthy living is understood in accordance with the definition of the World Health Organization: "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity."[1]

The multiple uses of geothermal water and the quality of life

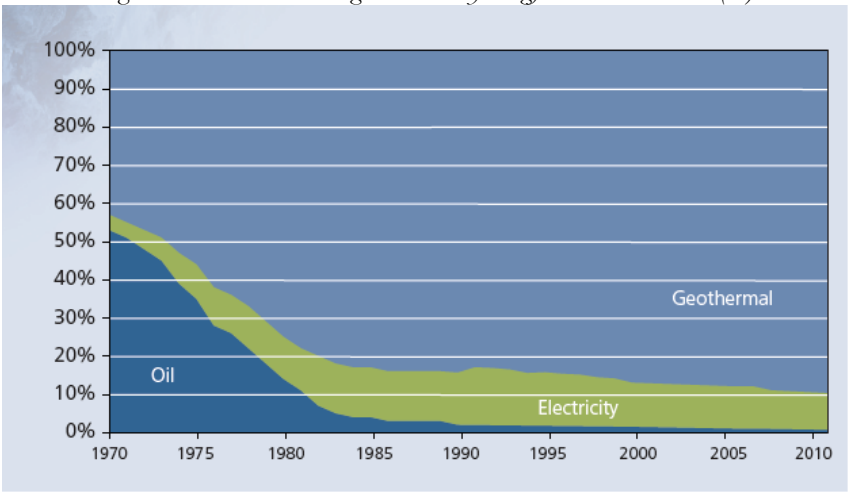
In the 1930s, utilizing geothermal energy was, in a sense, a last resort in Iceland, as it required a technologically novel and robust distribution system for which there was neither sufficient technological knowledge nor economic means. The idea at the time was to use peat for heating instead of oil and coal, as peat fitted into the existing distribution system, and the economic situation made the imported coal or oil too expensive for most of the population. But peat is a notoriously inefficient energy source. Making use of geothermal heat was another option, as it had shown to be quite efficient for directly localized heating around the country.

Yet as late as 1960, the Reykjavik Energy Authority expressed serious doubts about the possibility of using geothermal energy as a comprehensive solution for heating, due to both the damaging effects of corrosion and the technical complexity involved.

By the end of the WWII, nearly three thousand houses in Reykjavik were connected to the utility. The capital counted at that time 44,000 inhabitants. As shown in Figure 1, the proportion of people with geothermal heating had reached 23% by 1955. The oil crisis of the 1970s hastened this development, and by 1980 72% of houses in Iceland were heated by geothermal water. In the capital area almost every single house enjoyed this luxury at that time. By 2008, the share of exothermally heated houses was around 90%.

[1] http://www.who.int/about/en/index.html

Figure 2: *Residential heating in Iceland by energy source 1970-2010 (%)*



Source: *National Energy Authority. Energy data.*

As energy source, geothermal has, until recently, in most cases been less economical than oil or gas worldwide and heavily determined by the topographic context and its specific characteristics, the mineral composition of the water, and geological properties. Its advantage is predominantly to be found in its diverse possibilities for direct use when delivered to the users' doorstep. The main cost has to do with the initial investments in the distribution system, and the development of efficient means of heat retention. When the infrastructure has been fully paid for, however, it becomes a perpetual system where reducing the energy loss in the distribution process is the major issue.

In order to clarify this, a comparison with electricity can be helpful. As Thomas Hughes points out (1983), the transmission of energy requires large technological systems such as the electricity grid, an interconnected network for delivering electricity from suppliers to consumers. If the technological specifications or solutions have been agreed upon, it is a patentable formal system that turns into a universal solution. The power source can be different but turned into a commodity it becomes generic.

The technological solutions must be transferable as a codified knowledge embodied in standardized tools or equipment. Electrification and the enormous technological advances in its utilization go hand in hand.

Harnessing geothermal energy and transforming it into a commodity is a notably complex task. The construction of the system is based on what Michael Polanyi (1966) terms as 'tacit knowledge,' embedded and difficult to transfer, in comparison with 'formal knowledge', i. e. codified. Early attempts in Iceland were governed by a pressing need, rather than practical or economic feasibility. Looking backwards, the stubborn attempts at constructing a distribution system for the direct application of hot water were in the service of an unrealistic goal, with numerous problems: corrosion; pressure; and, if the water was distributed directly, a substantial loss of energy. Iceland's current distribution system for the geothermal has been a major practical as well as engineering accomplishment (Þórðarson 1998). It is based on practical needs rather than 'calculative rationality' in a Weberian sense.

Utilisation of geothermal waters

In this section we first present a brief overview of the utilization of geothermal energy in Iceland in the last century, before examining in more detail how this natural resource is used to enrich everyday life in Iceland and improve living.

Iceland's rich geothermal sources were hardly exploited up until or in the middle of the 20th century. Geothermal water was long used for bathing and cleaning, as well as for social purposes (Kristmannsdóttir and Halldórsdóttir 2008). There is also evidence that the hot water was used to combat various illnesses, such as arthritis (Þorsteinsson 2005). There is, however, little indication that geothermal water was used for space heating until the 20th century. In fact, wellsprings were at all times an unreliable irritant rather than an asset.

In terms of energy, the use of geothermal water for heating was first implemented in the city of Reykjavík during the thirties. In 1930 the Reykjavík Heating Utility was founded. The initial instillations were made in a geothermal field near the city centre, Laugardalur (literally "hot spring valley"), using a drill, originally intended for gold mining in the city (Gröndal 1926). This "gold drill," as it became known, had been brought to Iceland in the twenties, started when the city was drilling for fresh water in 1904-5. The "gold rush" of the early twenties was short-lived, and many officials, who also happened to be members of the Association of Chartered Engineers in Iceland, the group responsible for bringing the drill

to Iceland, lamented the fact that such an investment had gone to waste (Jónsson and Theodórsson 2003). Thus ideas were floated to use the drill for the production of electricity, generated by turbines propelled by the steam of the geothermal fields in Laugardalur, as had been tried by then in Italy. In 1928 the first drilling ensued, but it soon became evident that the water was more suitable for a heating utility.

At that time the city of Reykjavík was growing around a hill named after a cairn which had been built on top of it, known as the "school cairn." On this hill's eastern and south-eastern flank, facing towards the Laugardalur, an elementary school and the National Hospital had been built, an indoor swimming pool was under construction (completed in 1936), and nearby atop the hill was the house Hnitbjörg, home of the sculptor Einar Jónsson, an Icelander of international repute during those times. The first building to receive hot water from the Laugardalur geothermal fields was the schoolhouse, and later the swimming pool. Subsequently the water served 70 houses as well as the National Hospital. The experience from this small heating utility was successful enough that the city's officials, despite the substantial difficulties in its implementation, decided to heat the whole city with geothermal hot water, but that required fields with more productive capacity than the ones in Laugardalur. In 1933, the city thus made agreements with landowners in the neighbouring municipality of Mosfellsbær, some 30 km away, for utilising all hot water the city would find on their land.

It is during World War II that the uses of hot water emerge in earnest. Based on the initial experience at Laugardalur and a history since Iceland's first settlement in 874 AD of washing, bathing and. The heating of individual houses with hot water, the project of heating the whole city of Reykjavík was novel task.

The pipes and infrastructure necessary for pumping hot water to Reykjavík from some 30 km away had to be imported (Sigurðsson 1947). The most acute need at this time was the securing of funds for the project, as no currency was available in Iceland for such a large investment (Þórðarson 1998).

These funds were secured from Denmark in 1939 with the mediation of the Icelandic National Bank, and a Danish company was contracted for the work. Although funding was secured, only part of the material for the heating utility was obtained prior to the German occupation of Denmark in 1940, and due to the occupation that summer all operations on the

heating utility ceased. In 1941, the US offered Icelanders the opportunity to make a prioritised wish list of equipment and materials, to be provided as development aid in exchange for the stay of their occupying forces. The materials and tools for the building of the hot water utility were on top of the list. The US favourably disposed to the idea but being by then full participants in the war, could not meet these demands as metals and related materials were needed for armaments. As a token of Iceland's strategic importance in the war, and after a little lobbying in New York from Reykjavík city's engineer and a representative of the Danish company, the materials requested were delivered almost immediately (Jónsson and Theodórsson 2003; Þórðarson, 1998).

The geothermal and the rhythm of everyday life

As times go by, remarkably innovative ways of using geothermal water have come to light, of which, along with space heating and the visit to the outdoor pool, cultivation in greenhouses has shown to be the most important. Indeed, a recent study shows that of the 72 firms that were using geothermal water as an input into their production process in 2013, 32 used the resource to heat greenhouses (Hagfræðistofnun, 2013). An additional 24 firms used geothermal water in their fish farming activities.

Various attempts were made in the 19th century to use geothermal water for outdoor cultivation of crops such as potatoes, but the first greenhouse was built in 1933 (Georgsson, Sæmundsson, and Hjartarson 2005). Since then, several important greenhouse clusters have emerged in the country.

Swimming pools. There are over 2 million visits annually to the exothermally heated outdoor swimming pools in Reykjavík (population 250,000). The hot tubs situated beside the pools have become the most frequented gathering places in the country. The tubs are visited daily by young and old and social status is insignificant. Outdoor bathing has become one of Iceland's major tourist attractions, the Blue Lagoon being the best-known site. The outdoor pools are community-driven public spaces, inexpensive for the general public. They are also tourist attractions in their own right.

Greenhouses. The costs associated with year-round growth of vegetables and flowers have become competitive with, or less than, the costs of imported products in most cases. Increasing skills, technological

improvements and rapidly changing consumption preferences towards lighter fare have increased the significance of greenhouse cultivation substantially in recent years.

It is difficult to envisage the wide-ranging impact the use of the geothermal has had on the everyday life of Icelanders. The transformation of one neighbourhood in Reykjavík, Vesturbær, and the way the swimming pool in the area became one of its central institutions is a telling case.

In the late 1930s, the Reykjavík authorities envisioned Vesturbærinn as a thoroughly planned "suburb" in harmony with theories of the modernizing process of natural urbanization—a logical move for the bourgeoning town, the nation's capital. The seemingly controlled urbanization of Iceland took a U-turn in 1940 with the arrival of the British army. The British, and later US, occupation made the previously conceived city planning almost meaningless, increasing the number of inhabitants by 25,000 in a city of 40,000. After the British soldiers were gone one year later, the barracks they left behind, which were constructed to last for four or five months, became permanent accommodation for Icelanders newly arrived in the Reykjavík area. This was at the same time as the new international airport was constructed in the Reykjanes area which became a permanent location of the American army.

These barracks transformed whole outskirts, of which the biggest one was in Vesturbær, the area that was intended to be the model for future development of the city. The writer Einar Kárason accurately described the surroundings as "tin cans, fallen over and half buried in the ground," deteriorating into leaky, rusty huts unfit for decent living in the cold winter nights (Kárason 1989).

Every neighbourhood has an identity of its own, and the residents maintain loyalty to their local traditions. This was partly true of the poverty-ridden community in the area. It had a football team, a cinema and an amusement park. The cinema, inherited from the British and located in one of the barracks, was named after the Lebanese town of Tripoli, and the amusement park, which included the dance hall "Winter Garden," was given the name of Copenhagen's famous amusement park, Tivoli. Neither Tripoli nor Tivoli had much resemblance to the places they were named after. The fear of the political consequences of frightful slums was a by-product of rapid urbanization and was dramatically expressed by Le Corbusier (1989): "Architecture or revolution" (to this respect cf. del Acebo Ibáñez 2007, 2004-2005, 1996, 1993).

As in the case of so many modernistic projects of the era, the overall plan of the neighbourhood lacked the homeliness of the street culture with its vividness that transformed suburbs into tightly knit communities, as it was discussed in the work of Jane Jacobs (1961). Even the most downtrodden slums have a place for playfulness and belonging, which was lacking in the strictly formal organization of the Vesturbær neighbourhood.

"A city is a place where people can learn to live with strangers," is Richard Sennett's well-known definition (Sennet 2005). Public places in which people feel comfortable conducting routine social interactions, with acquaintances as well as strangers, are crucial for every community. To maintain such comfort requires a certain level of distance as well as proximity. Edward T. Hall (1973) has defined the 'proxemics' of intimate space as the closest 'bubble' of space surrounding a person, and he maintains that the sphere is culturally embedded. Here the metaphor of the "bubble" is appropriate, as everyone has limits which other individuals, acquaintances or complete strangers, have to respect. Hall defines social and contextual spaces in which people feel comfortable conducting routine social interactions with acquaintances as well as strangers. Sennett sees this as one of the most important characteristics of urbanization (Sennett 2005, 16). For Henri Lefebvre (2004), the "rhythm of everyday life" manifests itself in the neighbourhood, where repetition and place converge—this is 'locatedness,' or the lack thereof.

The outdoor swimming pool as a social gathering place

As strange as it may sound, the local outdoor swimming pool became a centre for everyday gatherings all year round in Iceland. At first, the most important function of such pools was to teach local children to swim, and, in several areas, for locals to have a decent place to clean themselves. But quite rapidly, people of various backgrounds began to use the pool's hot tub, a Jacuzzi-type bathing facility, as their daily meeting place (Ívarsson 2005).

The hot tubs in the Vesturbær neighbourhood swimming pool were erected in 1961, and the hot tub concept was imitated nationwide. Despite the widespread discourse about the ambivalent relationship between the public and the private in modern society, it is remarkable how swiftly an outdoor hot tub can become such an important institution. Within the

next two decades, the tub became the most popular place for social gatherings in the country, comparable to the Parisian café, the English pub, the Mediterranean church plaza, the ancient Turkish Hammam, and, closer to home, the Finnish sauna.

To sum up, without overemphasizing the impact of the geothermal on the Icelandic society, it has changed the rhythm of everyday life for its population, and increasingly so. Icelanders enjoy the comfort of inexpensive heated homes, and easily accessible year-round public spaces where young and old can gather irrespective of social standing.

Vegetables and flowers are now grown all year round

Farmers, and for that matter most Icelanders, have never been much into their greens. What was considered food, historically, was fat mutton. The farming of root crops and vegetables was always of secondary importance compared to the breeding of grazing animals; its place in the diet was considered supplementary at best. Icelanders, the logic went for most of the nation's history, should live on what could be reaped from Icelandic soil (Jónsson and Jónsson 2011).

For centuries, about 90% of food consumed was of animal origin, whereas cereals were absent due weather conditions. Milk, butter, mutton, suet, fish and other animal-based foods dominated the Icelandic diet to an extent almost without parallel in Europe, except perhaps among the nomads in far-northern Europe, e.g. the Sami in Lapland and the Inuit in Greenland.

In general, the palate was not a big issue in the post-war period up until the beginning of the eighties. This is not to state that food did not matter. Manual labour was widespread, close to being dominant around the country. Everyone ate salted cod on Fridays, and lamb on Sundays (you could choose between saddle of lamb or leg, cut or uncut, so you had more or less four variants). You had meat days, fish days and Sunday steaks.

Foreigners and Icelanders educated abroad were, however, experimenting with gardening and growing of root crops and fruits early on. The founders of the Icelandic Horticultural Association, in 1885, were seventeen men, eight of whom bore foreign names (Sigurðsson 1995).

In 1932, grapes were auctioned at one of Reykjavik's prestigious coffee houses, which indicates that the use of geothermal energy was not

only seen by a group of people as merely functional but in a hedonistic light. Using greenhouses to grow grapes (along with roses) and so enrich daily life could be understood as a protest by emerging urbanites. Flowers and fruits were signs of sophistication, a cultured attempt to survive under circumstances nearly unbearable for those who were at home with a better life abroad (Þórðarson 1998).

In the wake of the Second World War, Iceland, like most European countries west of the Iron Curtain, evolved into a consumer society, but the consumption of food remained more or less the same in the country. What finally brought about a change in food preferences and eating habits was the advent of mass tourism. This process worked both ways: tourists, coming from near and far, created demand for more and more sophisticated restaurants. The French, Italians and, later, the Japanese, often expressed their astonishment over the way the locals handled the good raw materials in the country. Icelanders, on the other hand, were sceptical of overseas food.

In the first years of tourism to the sandy beaches of the Mediterranean, Icelanders were cautious not to be too adventurous when it came to dining. This phenomenon, to feel at home abroad, is well known part of the modern 'tourist gaze' (Urry 2002), but as Icelandic tourists became more seasoned they started to appreciate the local gastronomy.

The availability of fresh fruit and vegetables all year round has changed consumption preferences in a fundamental manner, shifting emphasis from the local to the global and, probably, from the global back to local. In the case of Iceland, the global phenomenon of "summer all year round" was an especially marked break with the past; when asparagus from Chile, avocados from New Zealand and oranges from South Africa are commodities on the shelves, things are bound to change. This is already the case in most of the more affluent countries.

Carbon count labels are becoming more common to indicate geographical proximity. The New Nordic Kitchen is an example: a cuisine with roots traceable from field to fork, with an emphasis on vegetables and fish rather than meat. A paradoxical or even a provocative case is the New Icelandic/Mediterranean Cuisine; the "pizza generation" is moving towards lighter and healthier fare: fresh fish, greens all year round, locally grown tomatoes, capsicum, even eggplants are becoming more Icelandic than the Nordic fare.

Here we find the important changes when it comes to food, in terms of production as well as consumption. It has more to do with scale than scope. Access to abundant geothermal water, clean air and the use of state of the art technology is becoming more a question of preferences rather than technological or economic limitations. Radical innovations such as LED lightning and more ecological cultivation techniques make it possible to grow local produce that can compete with imports, tomatoes, cucumbers, even strawberries in dark winter nights. Iceland's rapidly increasing capabilities and skills in product development go hand-in-hand with the rising popularity of organic food. Here the inexpensive access to the geothermal is imperative.

The reemphasis on the local food might lead to Neo-protectionism, as is already the case in many of the more affluent nations. This will hardly be the case in Iceland. Iceland is a microstate and, as such, is deemed to be one of the most open economies in the world and will continue to be so.

Concluding remarks

It might seem misrepresentative to describe Icelandic society by focusing on a distinct energy source, but if view is shifted from the *source* to its *use,* the overall impact of geothermal on the quality of life for the Icelanders reveals itself.

Today the role of the geothermal heating utility in the well-being of the population is starting to emerge in manifold ways. The houses are made bigger in areas where these utilities have been built; a summer cottage without a Jacuzzi is less interesting; the number of swimming pools in Iceland is nearing 200) and almost solely outdoors. Almost 90% of the population now has access to the heating utility using geothermal water, and the high-energy geothermal fields contribute to the electricity production in Iceland. A visit to one of the pools in Reykjavík reveals that most people do not use the pools for training, but rather as a spa-like resort, a place of relaxation or other recreation; often visiting without actually swimming, but rather relaxing in the tubs and discussing current affairs.

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