LEGAL, REGULATORY AND ENERGY POLICY ASPECTS OF GEOTHERMAL ENERGY IN ICELAND

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ABSTRACT

In this paper. a brief description is given of the energy supply situation in Iceland, when gwthermal provided 44.1 % of the total p—— energy supply in 1993, and the counuy's energy resources. The Icelandic legislation on the ownership of energy resources is described as well as the framework of parliamentary and governmental intervention into geothermal development and regulation of the geothermal indusuy.

The paper then goes an to describe the role of geothermal in Icelandic energy policy since World War II, outlining the role of Government in promoting geothermal developments. including expanded promotional activities in the wake of the "oil crises"; acivities which have teen instrumental in raising the share of geothermal in the space heating sector from less than 50% in 1973 to 86 % 1993.

Another important pan of Icelandic energy policy over the last three decades is discussed, viz. the effons to utilize the country's energy resources, which have been exploited to a minor degree, for industrial purposes. especially energy-intensive production processes and for export of electricity.

Finally, the paper mentions that the Government is currently reconsidering elements of the country's energy legislation following Iceland's ratification of the treaty on the European Economic Area, EEA. and possible ratification of the European Energy Charter.

1. The Energy Supply Situation in Iceland

The share of energy sources in the primary energy supply in Iceland in 1984 - 1993 is shown in Fig. 1. (1)

As may be deduced from Fig. 1 the share of geothermal in the total primary energy supply in Iceland in the decade 1984 - 1993 ranged between 42.9 and 45.9 %. This is by far the highest share of geothermal in the primary energy supply of any country in the world. The reason for this high share of geothermal is primarily dominant position in the space beating sector where this energy source provides 86 % of the requirements and the heavy weight of this sector in the overall energy use, which is due to Iceland's geographical position and cool climate. In addition, there is considerable use of geothemal in Iceland for other purposes such as greenhouses, swimming pools. industrial drying, aquaculture, power production and de-icing.

2. Iceland's Energy Resources'''

For practical purposes, Icelands domestic energy resources are restricted to hydro-electric power and geothermal heat. No commercially exploitable resources of coal, oil, m a l gas or uranium have been found within the country´s economical zone and the prospects that they will be found must be considered meagre.

The hydro-electric resources are estimated at 64 TWh/year of technically exploitable power with present-day technology. Of this, some 40 TWh/year are believed to be harnessable at a sufficiently low cost to be of interest as a power source for power-intensive industries

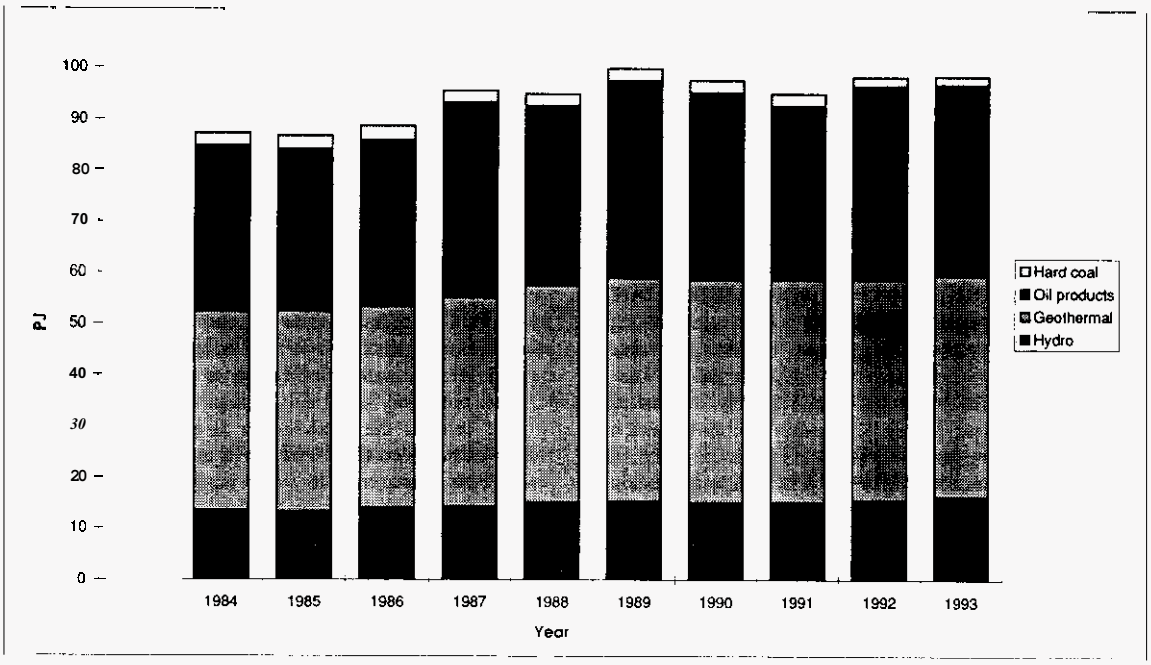

Fig. 1: Shares of Energy Sources in the Primary Energy Supply of Iceland 1984 - 1993

or for export via HVDC submarine cables. A part of these 40 TWh/year will probably entad unacceptableenvironmental impacts and never be developed far that reason. The potential that is both economicallyand environmentally harnessable may be expected to lie in the range 30 - 35 TWh/year. The present firm electricity production capability from hydro is 4.5 TWh/year.

The geothermal potential is less well known. It has been estimated that with present-day technology some 3500 exajoules (EJ) of heat could be extracted from the uppermost 3 km of the earth's crust in the country, of which some 100 El are extractable from specified so-called high-temperature areas. The present rate of geothermal extraction is about 0.05 El of heat per year, so that the current R/P ratio or resource "lifetime" is 70 000 years for the country as a whole and 2 000 years for the high-temperarun areas This shows that so far the technical geothermal potential of Iceland has only been utilized to a negligible degree.

3. Icelandic Legislation on Ownership of Energy Resources

The ownership of energy resurccs is dealt with in two pieces of legislation, viz. the Water Act of 1923,"' which covers riparian rights, including the right to use falling water to generate electricity, and the Energy *Act* of 1967[4], which deals with both hydroelectric and geothermal energy. The basic provision of both these Acts is that ***ownership of energy resources rests with the owner of rhe land conraining the resource.*** This ownership is. however. subject to numerous restrictions in both laws, especially the Energy Act, as will be described later.

A geothermal developer in Iceland who does not own the land can either buy it or acquire the right to develop the resource through a contract with the landowner by paying him a once-for-all or annual compensation for that access. Both methods have been used. By and large. this system has worked reasonably well in Iceland.

One important drawback of the present sytem that may he expected to cause problem in the future stems from the fact that large parts of Iceland, including the Central Highlands, which contain some of the most important geothermal fields in the country (and also a substantial part of its hydro resources), may have no owners since they are uninhabitable and through centuries their only use was for summer grazing of sheep and some freshwater fishing. Large parts of these areas have the status of "commons".

Modem technology and the growing importance of energy has radically changed this situation in a few decades. but legislation is lagging behind. This ambiguity in ownership has already given rise to a dispute between the State and local municipalitieswhose inhabitants had for centuries been using the ana in question for grazing and freshwater fishing, with both parts claiming ownership. A Supreme Court ruling came to the conclusion that neither part had conclusively proved its ownership, hut that the State, by virtue of the executive power vested in it by Parliament, was empowered to make such arrangements for the utilization of the energy resources of the area in question as it considered would best serve the interests of the general public, provided that any infringements with traditional uses caused hy such developments were duly compensated for. In the view of many Icelandic lawyers similar rulings could, under the present state of the legislation. be expected in other similar cases affecting the Central Highlands.

In the view of the present author this state of affairs is entirely unacceptable for *any* length of time. The uncertainty it creates may well hamper investments in geothermal developments in the Cenual Highlands and its fringes which may well be even more "grey" in this respect.

The present Minister for Industry has tried hard to create more clarity in this legislative mess. but so far he has not been able to enlist sufficient political support for his proposals.

4. Parliamentary and Governmental Intervention into Geothermal Developments and Regulation of the Geothermal Industry in Iceland

A Short Historical Outline of Geothermal Developments in Iceland

Hot springs have been utilized on a small scale for washing and bathing, and occasionally for space heating, in Iceland almost from the settlement of the country in the late 9th century. Modem geothermal utilization, mostly for space heating, started in the fust three decades of the 20th century and was initiated by municipalities. After World War II, many municipalities established geothermal district heating systems. Such developments were limited to locations enjoying favourable conditions with cheap and easy access to geothermal resources in those years. Elsewhere, this mode of space heating was not competitive with the cheap oil of those days.

The horticultural industry of Iceland, using geothermal heating of greenhouses, was also established in the fust half of the present century, but has expanded greatly since then. In the late fifties the first industrial enterprises using geothermalk a t for drying were established, but their expansion has been slow. The fust geothermal power plants were erected in the sixties and seventies.

Parliamentary and Governmental Interventions

As mentioned above, the landowner's ownership of geothermal resources is in several ways restricted by the Energy Act through certain provisions that must be followed in the implementationsof that ownership right. The most important of these are the following:[4]

1. In case of geothermal development for electricity production. a concession by Parliament is required if the rated capacity of the proposed plant equals or exceeds 2 MW. In addition, a construction permission from the Minister for Industry is needed before actual construction can begin. If the rated capacity is below 2 MW but equal to or greater than 0.2 MW no concession by Parliament is required; only a construction permission from the Minister. For geothermal power plants with less than 0.2 MW rated capacity neither a concession nor a construction permission is required.

It is interesting to note that no similar provisions apply to geothermal developments for other purposes than power generation, which do not even require permission from the Minister. This differencemay reflect the importance assigned by the legislators to a safe and reliable power supply.

2. Before development of a geothermal field transsected by boundaries between two or more landowners, where development by one landowner may affect the possibility of other landowners to utilize their part of the field, an assessment must be made by an independent body, either agreed upon by the landowners involved or appointed by the authorities. of the proportional share of each landowner in the energy contained in the field.

3. In case a landowner does not want to be involved in geothermal development on land used by a tenant, the laner is entitled to such a development at his own expense subject to the condition that it does not in any way cause damage to the land. Upon departure of the tenant, the landowner is not obliged to redeem the development cost over and above such cost as would follow from a development intended solely for domestic and farming purpose.

4. A special permission from the Minister for Industry is required for exemption of the right to geothermal development by sale, gift or any other means from ownership of the land. Purchase of such rights shall be subject to the same provisions as the purchase of land.

5. The sale of land containing geothermal resources shall be subject

to the provisions of the Act No. 65, May 31 1976, in such a manner that the Treasury shall have priority option immediately after the parties to whom this is granted under that Act. [This Act concerns land use for agricultural purposes].

6. The Minister for Industry is empowered to expropriate geothermal resources where he deems such an action to be in the interest of the general public, either to harness the resource or to prevent drilling in the neighbourhood of an existing production facility from damaging such utilization. In the case where an expropriation is effected for the purpose of a new development the landowners and tenants are obliged to surrender land necessary for construction of production and transmission facilities and to bear with limitations in their right of use of the land and other inconveniences caused by construction activities and operation and maintenance of the facilities. Full compensation for such limitations and inconveniences shall be rendered on basis of an agreement between the parties. or, if such an agreement cannot be reached, on basis of an arbitration.

7. The State is empowered to carry out exploration and research into geothermal resources throughout the country by any means, including drilling. A landowner or a person in control of land is obliged to grant to persons commissioned by the State to undertake such explorations or research unhindered access to the land for that purpose. In case such activities entail damage to the land or loss to the landowner, he shall be compensated in full according to an agreemen, or. if this cannot be reached, according to arbitration.

8. Spoiling of a geothermal field by landfill, drainage or any other means is prohibited except for protection of the land or its use or existing geothermal utilization already authorized.

9. All facilities for gwthermal production, transmission and distribution shall be constructed so as not to entail hazard, substantial traffic interference or damage to property of another person that is not obliged to abide according to a special authority.

10. The National Energy Authority is entitled to receive at its discretion information on temperature, occurrence of hot water or steam, drill cores and other geological data from any borehole deeper than 10 metres.

Regulation of the Geothermal Industry

Government regulation of geothermal production. transmission, distribution and sale b limited to public geothermal utilities that sell hot water or steam to the general public. The Energy Act of 1967 contains the kgal provisions governing this regulation. The most important ones are the following[4]:

1. The Minister for Industry is authorized to grant to municipalites or unions of municipalities monopoly right to operate district heating services and sell hot water or steam to the public, subject to provisions laid dawn in the Act, within a supply area specified by the Minister. Normally, but not always, the boundaries of the supply ana coincide with municipal boundaries. With the consent of the Minister, municipalites may transfer such rights to companies or individuals for a specified period of time subject to certain conditions and obligations to be fulfilled by the recipient of these rights.

2. Granting of monopoly rights by the Minister is subject to the condition that the municipality applying for such right provides designs of the heating system that are deemed technically sound by the authorized adviser to the Minister, The National Energy Authority, and that sound and well-based cost estimates show the undertaking to be national-economically well founded and likely to provide the customers with an adequate and reliable service.

3. Once a monopoly right has been granted to a municipality, it shall set a tariff for the services provided before operation can commence. The tariff and any change thereof is subject to approval by the Minister.

Other parts of the gwthermal industry in Iceland than public geothermal utilities are not subjected to Government regulation or intervention apart from those provisions of the Energy Act which relate to safety and preservation of resources. which apply to all geothermal installations.

5. The Role of Geothermal in Icelandic Energy Policy since World War II

As mentioned previously the principal actors in modem space heating geothermal developments in Iceland were municipalities. Later on the State established some industrial applications of geothermal energy. but has otherwise not teen directly engaged in development of this energy source. However, the State has played an imponant supportive role in such development all the time since World War II. Thus, State guarantees of foreign loans taken by municipalities for geothermal developments were provided which often was of a decisive importance for obtaining such loans and affected the interest rate in a positive way for the borrower.

In the early sixties the Geothermal Fund was established by law. Through the Energy Act of 1967, this fund was merged with the Electricity Fund, which had been established by law in 1946. into the so-called Energy Fund. As far as geothermal energy is concerned the purpose of the Energy Fund is twofold (1) To provide low-interest loans to municipalities, firms or individuals for geothermal drilling both for public supply, use in horticulture and similar economic activities and heating of individual homes, especially in rural areas, and *(2)* sharing by the State in the risk of gwthermal developments undertaken by developers. This is effected through a provision in the Energy Act stating that if an attempt to develop a new geothermal field through drilling partly financed by a loan from the Energy Fund is unsuccessful the loan may be converted into a grant and does not have to be repaid. Loans for drilling provided by the Energy Fund normally cover 60 % of total drilling costs. This arrangement has been instrumental over the pears in furthering geothermal developments in Iceland. The provision applies :o whale fields instead of individual boreholes since it is considered normal that not all drillings in an otherwise successful development yield water or steam.

Another aspect wkre the State has played a very important supportive rok b geothermal exploration and research, carried out by the National Energy Authority (NEA), a Government institution under the Minister for *Industry*. The NEA was established by the Energy Act of 1967. hut the research and exploration activities date back to the late fourties when they were undertaken by the State Electricity Authority (SEA), the predecessor to the present NEA. *Also* in the late forties. a State-owned *company,* The State Drilling Contractor, was established under the Minister for Industry for the purpose of providing drilling services to geothermal developpers which until then had not teen readily available in Iceland with state-of-the-an technology. Scientific. mainly geological, geophysical and later geochemical, methods have been used by the NEA Geothermal Division, and later others as well, for geothermal exploration. Over time, these methods have gradually been improved. new ones developed and adopted from abroad. leading to a much greater success and efficiency in exploration work. It may safely be said that this systematic and scientific approach to exploration, combined with enthusiasm and entrepreneurial spirit of the developers, have been instrumental in the great progress that has been made in the utilization of Iceland's gwthermal resources since World War II.

The ratwnak behind this policy has all the timc been encouragement of geothermal space heating schemes. Even when oil was cheap, geothermal could provide still cheaper heat for space heating at a number of locations in Iceland. Balance of payments and foreign currency considerations also played a part since all oil had to be purchased abroad and foreign currency was often scarce in those years.

Between August 1973 and April 1974 the price of gas oil, the oil type most widely used for space heating in Iceland, rose by 67 % *in real terms*, and between December 1978 and June 1980 it rose again by 88 %. Other *oil* types increased correspondingly in price. These price hikes had serious national-economic repercussions in Iceland and increased the difference in heating costs between those having access to geothermal heat and those using oil heating which put pressure on the authorities to speed up the transfer from oil heating to geothermal heating wherever possible. "Reduction of the oil bill" of the country gradually became a major item in its energy policy and the efforts to substitute oil for space heating by geothermal were multiplied. Appropriations to the Energy Fund for lending to geothermal drilling and for the risk-sharing programme were increased; special arrangements were made to *secure funds* for lending to municipalities and other developers to construct distributions systems and appropriations to the National Energy Authority for geothermal explorations and research were increased. By this time the NEA had, through its research activities and adaptation to Icelandic conditions of progress made in other countries. greatly improved the exploration techniques for geothermal heat which now had made it possible to locate hot water sources in areas when hardly anyone would have dreamed of finding them a couple of *decades* earlier. As a result the share of geothermal in the space heating sector in Iceland rose dramatically during the late seventees and early eighties; from slightly less than 50% in 1973 to about 85 % in the late eighties.

6. Utilization of Geothermal in Energy-intensive Industries in Iceland

The energy resources of Iceland, both hydro and geothermal, are large in relation to their present utilization and in the case of geothermal in absolute terms also. Very early. therefore, attempts to establish in Iceland power- and heat-intensive industries became an important part of Icelandic energy poky in order to secure greater national-economic benefits from the energy resources. Many of these industries, like the production of aluminium and other non-ferrous metals, are first of all power-intensive. i.e. their electricity requirements are high per unit of output compared with industries in general. The most common use of geothermal energy in the world is for power generation. The obvious option, therefon, would seem to be to generate electricity by geothermal for such industries. In Iceland, however, an obstacle to this approach is that power prcduction for such industries from geothermal *sources* is presently not competitive in cost with hydroelectric generation. As far as geothermal is concerned, therefore. attention has concentrated itself on industries that are heat-intensive rather than power-intensive. Several examples can be mentioned of successes in this endeavour. The best known is probably a diatomite plant in Northern Iceland which uses geothermal steam to *dry* diatomite mud pumped from the bottom of a near-by lake to process it into a powder used for various purposes in chemical and beverage industries. It is a unique plant in the world largely of Icelandic design. Another is a plant in Western Iceland using hot water to *dry* seaweed. Less successful and still plagued with technical and economic problems is a plant in Southwestern Iceland producing high-quality salt from hot brine, i.e. seawater heatcd naturally underground by geothermal sourccs. A number of similar projects have becn evaluated but not implemented among them alumina production from bauxite.

The great advantage of geothermal in this connection is cheap and essentially pollution-free heat. It has been shown that geothermal steam can be produced in *many* high-temperature fields in Iceland at a cost amounting to no more than 10 - 20 % of the steam cost from a fossil-fued boiler. The main disadvantage is limited economic mobility of geothermal energy. The cost of geothermal steam may easily double if it has to be transported by pipeline over a distance of 15 - 40 km, depending on the flow rate. Por hot water the distance is much longer. Besides, the optimal location of an industrial plant is determined by a number of factors other than energy *costs*, such as proximity to markets and raw materials, access to labour and services, land availability and so on A prerequisite for geothermal utilization for industrial purposes is therefore that the location of the source matches well into a pattern determined by these factors after the energy cost differential has been taken into account.

7. New Horizons in Icelandic Energy Policy

Up to this time, Iceland has been an island not only geographically but also economically to a greater extent than many of its neighbours in Europe. Foreign investments in the country have been minimal and restricted by law; even prohibited.

Winds of change are now blowing in this area. Iceland has joined the European Economic Ana, EEA. and may also ratify the fust part of the European Energy Charter Treaty, which further opens up for international considerations in the formulation of the energy policy of Iceland. While opening the door for international participation in energy developments among its signatories the European Energy Charter also strongly confirms as a basic principle the sovereignty and sovereign rights of each signatory over its energy resources. Implementation of this basic principle in the international environment created by the European Energy Charter Treaty may necessitate some modifications of Icelandic legislation on ownership of energy resources. This question is now under an active study by the Ministry for Industry. It is extremely sensitive politically in Iceland. It has traditionally been difficult to obtain consensus among a population as individualistic in outlook as the Icelanders for any legislative change that might possibly affect land ownership

Participation by Iceland in both the European Economic Area and the European Energy Charter Treaty may well affect the investment climate m the country as felt by potential foreign investors, both as regards investments in energy production and transmission and in energy use facilities like power- or heat-intensive industries. Thus, these new winds of "internationalization" may well affect the success of the efforts by successive Icelandic governments to attract energy-intensive industries to the country. *On* the success of those efforts will depend the degree to which the country's unused energy resources will *make* increased contribution to the national economy.

In recent years another possibility, besides energy-intensive industries in Iceland, of increased utilization of the country's energy resources has been considered with growing seriousness, viz. export of electricity via HVDC submarine cables to Northwestern Europe; primarily to the U.K., but both the Netherlands and Germany have also becn considered as potential buyers. Such power export is thought of as a supplement to energy-intensive industries in Iceland rather than as an alternative to them. To a certain extent these two possibilities would be in Competition with each other which by itself may be considered beneficial. Also, interconnection of the Icelandic power system with that of Europe would upgrade Iceland's hydro resources considerably since *dry* years in Iceland could then be compensated for by a "buy back" of a part of the power scheduled for export.

For geothermal, this would involve convening it to electricity rather than using the heat directly. At present. this is not competitive with hydro on a major scale. On the other hand, power export in parallel with local industries speed up the utilization of the cheapest hydro resources and thus bring nearer the time when geothermal becomes competitive with the remaining hydro.

Presently the margin between the cost in Northwestem Europe of power from Iceland and local production cost of electricity from fossil fuels there is far too small to warrant the huge investments and the risks involved in such a scheme. Carbon dioxide charges in Europe, as proposed by the EU Commission, would enhance the competitiveness of power from Iceland. Such taxes do not seem to be imminent in the major EU countries, however. *As* things now stand, therefore. there *may* well be 10 - 15 years before the first such export scheme will be realized.

Energy-intensive industries. partly or wholly established by foreign investors in Iceland, have MW been the subject of an - at times heated -

political debate in Iceland for up to 30 years. There have been and still are divergent opinions on this issue, but over the years they have tended to converge and now this issue may by and large be considered as politically mature. The same cannot, on the other hand, be said of power exports. Being a relatively novel issue it has been very little discussed on the political arena up to now. In the last two years, the Minister for Industry has made efforts to launch such a debate, both among parliamentarians and the general public. Hopefully, the question will have reached political maturity at, and preferably before, the time when the economy for such an aport is there and the few remaining technical problems have been solved.

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