

Iceland's Central Highlands: Nature Conservation, Ecotourism, and Energy Resource Utilization

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Abstract—Iceland's natural resources include an abundance of geothermal energy and hydropower, of which only 10 to 15 percent is currently being utilized. These are clean, renewable sources of energy. The cost to convert these resources to electricity is relatively low, making them attractive and highly marketable for industrial development, particularly for heavy industry. About 100 proposed power projects are in the process of being evaluated under the Master Plan for Hydro and Geothermal Energy Resources.

Expanding the use of renewable energy resources to build up heavy industry is seen by many in the current Icelandic government as the best way to develop and diversify the country's future economy. This would provide a much needed economic boost, and considerably more employment opportunities to rural communities, including the Eastern Fjords. However, there is growing public concern about the government's heavy industry policy and its possible detriment to Iceland's unspoiled wilderness and the fast-growing ecotourism industry.

Introduction

Most of Iceland's high temperature geothermal areas and some of its most powerful river systems are located in a vast, uninhabited, and unspoiled area known as the Central Highlands. This area has a high conservation value and is becoming increasingly popular with tourists, in part because of its barren landscape, unique volcanic formations, and spectacular glaciers. The tourism industry (13 percent) has now bypassed industrial production (11 percent) to become the nation's second most valuable source of currency income—the fish industry still being the most valuable at about 50 percent (OECD 2001). The Icelandic government is also interested in further promoting the development of ecotourism.

Iceland's economy depends heavily on a rich endowment in natural resources. The fishing industry depends on Iceland's marine resources, energy-intensive industries on abundant hydropower, and the tourism industry on nature and natural beauty. Both successful fish exports and ecotourism depend on the reputation of a pristine environment and a positive, "green" international image. The Icelandic government is currently facing a major decision. Should the government's efforts now be focused on developing the abundant power resources for electricity-intensive, heavy industry such as aluminum smelters in hopes of a large economic return, or should the government protect the unique volcanic landscape and sensitive ecosystems of the Central Highlands and concentrate instead on ways to expand ecotourism? The two policy directions, by their nature, may not be compatible, although the current administration is currently working to meet both energy development and nature conservation objectives.

This paper presents a brief overview of the geologic and geographic reasons for Iceland's abundant renewable energy resources, volcanic wilderness, glaciers, and fragile ecosystems. This is followed by a summary of environmental legislative activity through the 1990s. Two large government-run projects, the Regional Plan for the Central Highlands and the Master Plan for Hydro and Geothermal Energy Resources, will be discussed. Following this will be a discussion on current energy use in Iceland and a major study done in 2000 on ecotourism in Iceland. This paper will conclude with a discussion of the importance of an Earth systems science approach to the collection and analysis of scientific data to help governments make well-informed policy decisions.

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Volcanic Activity and Geothermal Power

Iceland is a young volcanic island, 103,000 km² (39,768 miles²) in size, that just touches the Arctic Circle to the north. It is located on the Mid-Atlantic Ridge, a divergent plate boundary between the North American and Eurasian plates, which are spreading apart at a rate of 2 cm per year (0.8 inch) (fig. 1). The spreading has been discontinuous along the rift zone, with perhaps no activity for 100 years, and then a 2-m (6.6-ft) spread over the span of only a few years, with subsequent volcanic and seismic activity. Iceland is also a surface manifestation of a large mantle plume or hot spot. The center of this hot spot, an area where heat flow and lava production is much higher compared to surrounding areas, is now located beneath the Vatnajökull Glacier in Southeastern Iceland (the largest glacier in Europe), part of the Central Highlands (fig. 2).

Figure 1—Location of volcanic systems in Iceland that have been active in post-glacial time (last 10,000 years) (figure redrawn from Einarsson 1994).

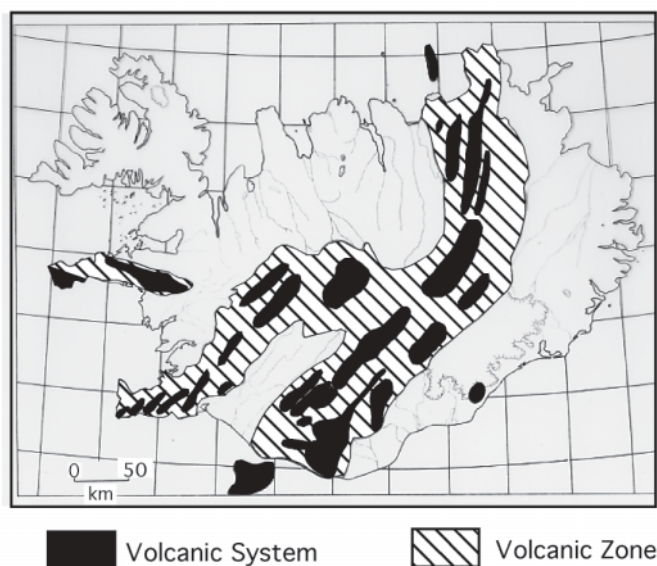


Figure 2—Map showing the main glaciers of Iceland and the defined boundary of the Central Highlands (modified from the Regional Plan for the Central Highlands 1999).



About 400 km (249 miles) of the otherwise submerged Mid-Atlantic Ridge is exposed above sea level in Iceland. The plate boundary through Iceland manifests itself with a central rift zone running in a northeast/southwest direction across the middle of the island. This zone includes, from the southern part to the northern part of the island, a total of 30 large active volcanic systems, each composed of a central volcanic complex and accompanying fissure swarm. Each swarm is usually 40 to 100 km (25 to 62 miles) long and 10 to 30 km (6 to 19 miles) wide. There is more variety of volcanoes and diverse volcanic activity here than in any other part of the world.

On average, there is a volcanic eruption in Iceland every 4 to 5 years, and this frequency has been increasing over the last 20 to 30 years. The unique location of Iceland on a plate boundary, with all of its varied volcanic and ground-rifting features, geothermal activity, and glaciers, makes Iceland an important study area for the Earth sciences. In Iceland, both the internal and external forces that create and erode the land are easily observed.

The abundance of volcanic activity is the reason for Iceland's abundant geothermal power. There are numerous geothermal systems, ranging from fresh water to saline and from warm to super-critical temperatures. The low temperature geothermal fields, registering 20 to 100 °C (68 to 212 °F), are primarily utilized for house heating and are mostly found outside the active rift zone. The high temperature fields, with water steam up to 350 °C (662 °F), are found inside the rift on the plate boundary where volcanism is most active (fig. 3).

Meteoric water percolating down through the porous lava fields is heated by the shallow magma lying beneath the island, circulates, and is brought back to the surface in the form of hot springs, geysers, and boiling clay pits. High temperature fields are harnessed primarily for electricity generation, but only a small fraction of this resource has yet been tapped. One reason is that most of the high-temperature geothermal fields are located in a remote part of the island—the Central Highlands.

Glaciers, Glacial Rivers, and Hydropower

Glaciers, large and small, cover about 11 percent of Iceland. The largest is the Vatnajökull Glacier, about 8,130 km² (3,139 miles²), with a large number of outlet or valley glaciers flowing down to the surrounding lowlands. Vatnajökull, together with Langjökull and Hofsjökull to the west, are the three crown jewels of the Highlands. All glaciers in Iceland are temperate glaciers and very sensitive to climatic changes resulting from global warming. Glacial meltwater accumulates to form forceful glacial rivers that flow rapidly over steeply mountainous terrain, forming deep canyons and abundant waterfalls as the water moves to the coast, supplying the island with an abundant but largely untapped source of hydropower.

The areas of greatest future hydropower potential are north of the Vatnajökull Glacier and in south-central Iceland, west of the Vatnajökull Glacier (fig. 4). Both

Figure 3—Geothermal power potential in Iceland. Location of low and high temperature geothermal fields in Iceland (figure courtesy of the National Energy Authority, Iceland).

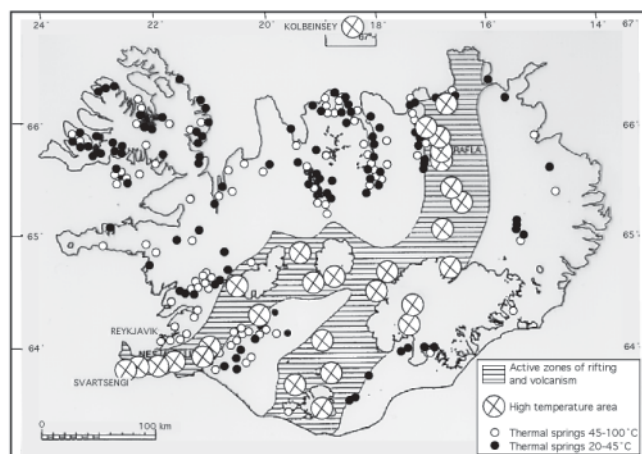
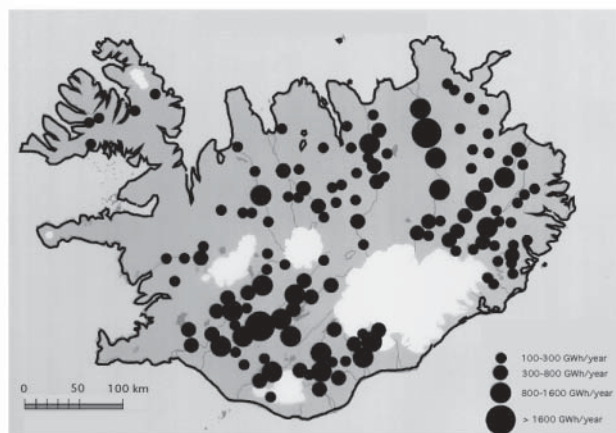


Figure 4—Hydropower potential in Iceland. Calculated direct runoff energy in each 20 km step along rivers (figure courtesy of the National Energy Authority, Iceland).



areas are known for their varied volcanic landforms and high ecological sensitivity. In south-central Iceland, there currently exists several hydropower plants, but the area could be further utilized. The area north of Vatnajökull is still untapped, although a recent proposal by the National Power Company to build a 750 megawatt hydropower plant is being considered.

Wilderness of the Central Highlands

Iceland is sparsely vegetated. Only about 30 percent of the country has good (more than 75 percent) or fairly good (50 to 75 percent) vegetation cover (OECD 2001). Fifty percent of the island is completely devoid of any vegetation, if the extent of glaciers and lakes are included, and the remainder is very sparsely vegetated. The vegetation is comprised of grassland and cultivated land, as well as moss heath, heath, and wetlands. Woodlands (mainly birch) are less than 1 percent of the country. Wetlands, on the lowlands close to the coast, used to be prominent, but most have been drained for agriculture. Iceland has 485 vascular plant species (including 100 introduced species), 560 species of bryophytes, and 510 species of lichens. There are only four species of terrestrial mammals (arctic fox, mink, reindeer, and mice), the arctic fox being the only indigenous one. Bird life is a bit more diverse with 75 nesting species, although 32 species are rare. About 1,250 insect species have been identified (OECD 2001).

The Central Highlands are about 40 percent of the total land area in Iceland (an area the size of Switzerland). The highland plateau is uninhabited open volcanic wilderness with wide vistas, where visual signs of human activities are only limited to road tracks and scattered mountain huts. Most of the area is covered by lava fields, volcanic sand, and gravel. The most active and largest volcanic centers are in the Central Highlands.

The porous volcanic soil in Iceland is fertile, but lacks cohesiveness because of high volcanic ash but relatively low clay content. This makes the soil prone to erosion by wind and water. Subsequently, Iceland experiences rather severe soil erosion due to winds and harsh weather. The areas experiencing the most severe erosion are the areas that also lack vegetation cover, as is the case in the volcanic wilderness of the Central Highlands where the vegetation cover is at best sporadic to none, with only occasional "oases" of continuous vegetation in low-lying areas where there is a high ground water table. Low precipitation in parts of the Highlands is also a factor. The area north of Vatnajökull is in a rain shadow, with precipitation less than 400 mm (1.3 ft) per year, adding to the soil erosion and difficulty for vegetation to take hold. South of the Vatnajökull Glacier, precipitation is measured at more than 4,000 mm (13 ft) per year.

Decades of overgrazing in the lowlands and up into the Central Highlands, primarily by sheep, is also a contributing factor to soil erosion, although steps have now been taken to reduce the number of sheep stocks. There is strong evidence to indicate that at the time of the Norse Vikings' settlement of Iceland in the 9th century A.D.,

there was extensive birch forest cover and a climate that supported the harvesting of grain crops, with only 20 percent of the island barren.

Tourists come here to observe the unusual, “unearthly” beauty of the volcanic landscape. These moonscapelike features made the Central Highlands an ideal training ground for the Apollo 11 astronauts before the first lunar mission in 1969. This landscape is very sensitive to manmade structures such as power plants, dams, paved roads, high masts, and high-tension power transmission lines. Herein lies the conflict. Preserve the unique and untouched beauty of the Central Highlands for a profitable and expanding tourism industry, or utilize the tremendous hydro and geothermal power potential to give rural communities along the coast a much-needed economic boost.

Iceland's Regional Development Policy

The population in Iceland at the end of the year 2000 was just about 283,000 or 2.7 people per km². The majority of the population, approximately 175,000 people, live in the capital Reykjavik and surrounding area. One of the main concerns of the Icelandic government is the movement of people from the rural towns and villages into the capital for greater employment opportunities. Opportunities for employment are dwindling in the rural areas. During the 1989 to 1999 period, only two regions apart from the Capital area had modest population growth. In the rest of the country, population is declining (OECD 2001). The main objectives of the government's regional development policy are to strengthen urban settlement and encourage population growth in those communities that can promote diverse and prosperous economies by providing key services and by utilization of natural resources, both on land and on sea. There is a focus to reduce the movement of population to the Capital region in order to ensure optimal use of the nation's installations. Heavy industry is to be established outside the Capital area. Building an aluminum smelter in Eastern Iceland, where the population fell 20 percent during the 1989 to 1999 period, will have economic benefits, social benefits, and environmental consequences. High-tension power transmission lines carried on large masts will transport electricity from a hydroelectric power plant in the Central Highlands into the small, rural towns in the Eastern Fjords, and would then allow for the construction and operation of heavy industries such as aluminum smelters. This idea has attracted foreign investors and may revitalize rural communities and slow the movement of people into Reykjavik. Tourism in these rural communities is seasonal and, therefore, does not support continuous employment.

Land Use Planning and Wilderness Protection in the Central Highlands

Environmental Awareness of the 1990s

Increased environmental awareness in the 1990s led to an era of much dispute about the future of the Central Highlands and its possible development for renewable energy. During that decade, important milestones in Iceland's environmental legislation were enacted into law. In fact, environmental legislation was almost completely revised in the 1990s to take into account domestic objectives and international commitments. The decade began with the establishment of the Ministry of the Environment in 1990, responsible for nature conservation, physical planning and construction, public health, and pollution control. When Iceland became a signatory on the 1992 Port Agreement creating the European Economic Area (EEA), the country had to adopt most of the European Union (EU) environmental directives relating to air, water, waste, chemicals, foodstuffs, and environmental impact assessments (EIA). The remainder of the decade showed the enactment of a number of environmental legislations, including the Environmental Impact Assessment Act of 1993, with a revised EIA Act approved by the Icelandic Parliament in the year 2000, meeting the requirements of the 1997 EU directive (OECD 2001).

Regional Plan for the Central Highlands

In 1994, the Ministry of the Environment, and the Planning Agency established the Regional Plan for the Central Highlands in Iceland (1999). The main goal of the Regional Plan, which was approved in 1999 and runs to 2015, is to coordinate natural resources and land use in the Highlands in a sustainable way. Overseeing this Regional Plan is the Planning Committee with representatives from the associations of municipalities surrounding the Highlands. The Regional Plan was prepared in close collaboration with a large group of scientists, institutions, and individuals.

As a basis for this plan, an extensive biological and physical inventory was compiled, and analyses were conducted, based mainly on existing knowledge and data. The land in the Central Highlands was broken up into 55 land units, outlined on a series of maps (fig. 5). Each land unit was then analyzed and assigned value under several different categories. This type of analysis allowed for a visual overlay of landscape units, so each unit's value within each particular category could be compared. The main categories for evaluation and comparison included: (1) vegetation cover, biological diversity, and the extent of soil erosion; (2) areas of high protection value due to unusual geological formations and landscapes; (3) other areas of natural beauty and significance, as well as historical sites; (4) traditional utilization such as grazing, fishing, and hunting; (5) hydrological characteristics, including hydro and geothermal power potential; (6) tourism and recreation potential; (7) transportation and development of roads; and (8) sanitary issues in the Highlands.

The Regional Plan limits buildings and other structures to certain zones and leaves for conservation as much untouched nature as possible. Roads across the Highlands are to be kept to a minimum, sufficient for summertime traffic only. Offroad driving was banned throughout Iceland in 1999. Service centers for tourists are to be located primarily at the periphery of the Highlands to serve as a base for day tours within the Highlands, although there will also be smaller service centers within the Highlands. The Regional Plan does allow hydroelectric plants in the Highlands, but no geothermal power plants, at least for the time being. The results were definitive that there are large areas (comprised of several landscape units), both to the north and southwest of Vatnajökull Glacier, that have high values in many categories, including both high protective value and high power potential. Furthermore, the Regional Plan's objective to limit buildings and other infrastructure in the Central Highlands led to the enactment of the 1997 Planning and Building Act, stating that all Iceland, not just inhabited areas, is subject to physical planning and licensing.

Figure 5—Fifty-five landscape units used in the Regional Plan for the Central Highlands (1999).



Master Plan for Hydro and Geothermal Energy Resources

In 1999, the same year the Regional Plan was completed by the Ministry of the Environment, the Ministry of Industry and Commerce in cooperation with the Ministry of the Environment began work on the Master Plan for Hydro and Geothermal Energy Resources in Iceland (see also Thórhallsdóttir, this proceedings). The Master Plan was executed under the slogan "Man-Utilization-Nature" and in response to lively debate and public concerns regarding the future of the Central Highlands. A Steering Committee made up of 16 members, supported by about 50 experts working in four different Working Groups, was assigned the task to evaluate about 100 proposed power projects. The Steering Committee expects to finalize the evaluation of the first 25 project proposals by the end of 2002.

Land Rights and Land Ownership

The problems in choosing between various land use options relating to nature conservation and tourism, grazing or other traditional uses (fishing and hunting), and energy use are compounded by the fact that property rights in the Central Highlands are largely undefined. The Highlands, until recently had not been divided into municipalities, as no need for the land was perceived. Even today, few property rights are defined. Increasingly, however, the Highlands are seen in terms of their potential for energy production and ecotourism. A total of 34 surrounding municipalities now have interests in the Central Highlands and claim traditional user rights.

Government objectives for sustainable development in the Central Highlands depend greatly on resolving these land ownership issues. Two important laws were therefore adopted in 1998 to address this issue. First was the Municipalities Act, which subdivided the whole country into municipalities, including the Highlands, thereby extending subdivisions previously focused mainly on coastal areas. Each municipality has until 2007 to draw up a land use plan for its area, approved by the Ministry of the Environment. The second law, the Public Lands Act, sets out ways to delineate private land, public land, and upland range. Land, where no ownership can be proven by 2007, would be state owned. The designation of land as public land, however, will not cancel traditional user rights, and all decisions on land use will have to be subject to consultations with appropriate parties, and overseen by a special committee.

Similarly, according to the 1998 Act on Research and Use of Underground Resources, all extraction of ground water, minerals, gravel, and geothermal heat now requires a license by the Ministry of Industry and Commerce. Land owners, on private lands, are compensated through individual agreements or property size assessments. This Act does not cover the use of hydropower or geothermal steam for electricity production.

Establishment of the Nature Conservation Agency

Nature conservation also received a new legal and institutional base in the 1990s with the establishment of the Nature Conservation Agency. This agency, which is under the authority of the Ministry of the Environment, supervises the management of all protected areas in Iceland and is responsible for general nature protection, including monitoring the effects of human activities on the natural environment. The 1999 Nature Conservation Act defined the categories of areas subject to specific protection, such as areas of special biological value, areas with special or endangered species, key habitats, and ecosystems, and areas for recreational uses. This new Act takes into account many of the provisions of the European Union's 1992 habitat directive, but also covers landscapes. Types of landscapes that benefit from general protection under the Act include wetlands, lava fields and volcanic formations, lakes, and hot springs. The Act also allows national parks to be established on privately owned land. The Ministry for the Environment is to prepare Nature Conservation Plans every 5 years, with the first due by 2002. The Institute of Natural History, under the Ministry of the Environment, published in June of 2000 a detailed survey to assess the protective value of various habitat types in the

Central Highlands (Einarsson and others 2000). A national strategy for the conservation of biological diversity is also under preparation.

About 10 percent of Iceland's land area is currently protected. Ten new protected areas were established in the 1990s, representing 54,100 ha (133,684 acres), including a new wetland Ramsar site in 1996 in Grunnafjörður (OECD 2001). Most of the 83 protected areas are small, but this trend has also changed with the 1999 Nature Conservation Act. In the year 2000, 10,000 ha (24,710.5 acres) of Iceland's second biggest bay, Breidafjörður, with its many islands, was declared a protected area. In July of 2001, 91,500 ha (226,101 acres) on the tip of the Snæfellsnes Peninsula, including the Snæfellsnesjökull Glacier, an active strato-volcano and surrounding lava fields with unusual geological formations became the fourth national park in Iceland. By the end of 2002, territories under protection in Iceland may have doubled to 20 percent, with the proposed plans to expand the Skaftafell National Park (south of Vatnajökull) to include the entire Vatnajökull Glacier and some adjacent areas as one big national park. The Vatnajökull National Park would reportedly be Europe's largest national park. However, the park would not extend north or west of Vatnajökull Glacier, leaving open the possibility to harness the large glacial rivers that flow north from the big glacier for hydropower development.

Another proposed plan being discussed by environmental NGOs is to grant park protection to much larger expanses of the Central Highlands, including the area north of Vatnajökull Glacier.

Power Utilization and Ecotourism in the Central Highlands

Iceland's Power Potential

Iceland's electrical power potential, from combined hydro and geothermal sources, is estimated to be 50 terawatt hours (TWh) per year, taking economic and some environmental factors into consideration (National Power Company 1995). One TWh is equivalent to 1,000 Gigawatt hours. Electricity from hydropower is estimated to be 30 TWh per year, and from geothermal power 20 TWh per year. In 1995, only 4.8 TWh per year of this overall electrical power potential, or about 10 percent, was being utilized.

In the year 2000, of the total energy used in Iceland, 50 percent came from geothermal power, 32 percent from fossil fuels, and 18 percent from hydropower. That is a total of 68 percent of energy from renewable resources. The use of fossil fuels, in Iceland is almost exclusively for running automobiles and the shipping fleet, with only 0.1 percent used for electricity generation in the year 2000. Over 64 percent of the harnessed geothermal power is used directly for house heating. Other uses are electricity generation (16.9 percent), industry (6.6 percent), swimming pools (4.5 percent), greenhouses (3.3 percent), aquaculture (2.7 percent), and snowmelting (1.7 percent). On the other hand, hydropower provides 83 percent of electricity generation (National Energy Authority 2000).

General utilities consumed only 36.6 percent of the total electricity generated in Iceland in the year 2000. The remaining 63.4 percent was used by energy-intensive heavy industry such as two aluminum smelters and an iron-silica smelter (National Energy Authority 2000). The most rapid yearly growth in consumption of electricity has also been in the heavy industry sector (Iceland Statistics 2000).

Growth in Tourism

The total number of tourists visiting Iceland in the year 2000 was about 303,000 (Icelandic Travel Industry Association 2001), exceeding the total population of Iceland for the first time. Tourism statistics show that the number of foreign visitors has increased rapidly over the last few years. Annual foreign tourist arrivals nearly doubled from 1990 to 1999, from 142,000 to 263,000. Using this rapid rate of increase, it is now estimated that it will only take 10 to 15 years for the total number of foreign tourists to reach one million.

Recently, two surveys were conducted to better assess the impact of suggested hydropower plants in the Central Highlands on ecotourism. The first study (Sæthórsdóttir 1998) was done on behalf of the Ministry of Industry and Commerce

and the National Power Company, and the second study (Gudmundsson 2001) by the Icelandic Travel Industry Association (called for by the Master Plan for Hydro and Geothermal Energy Resources).

Based on Gudmundsson (2001), it was estimated that the total number of tourists visiting the Central Highlands in the summer of 2000 was as high as 115,000—the Central Highlands being one of the key attractions in Iceland. About 90 percent of foreign tourists and 86 percent of Icelanders cite enjoyment of nature as being the most important reason they come to the Central Highlands. Enjoyment of the view, simply being outdoors, and to experience peace and quiet complete the top four reasons visitors come to the Highlands. While there, planned leisure activities include photography, bathing in hot springs, short and long hikes or walks, bird watching, observing subarctic ecosystems and geological formations, and glacier exploration.

An overwhelming majority of visitors to the Highlands were against structures such as hydropower or geothermal plants in the same areas they were visiting. As high as 94 percent of foreign visitors and 91 percent of Icelanders regarded hydropower structures such as dams, manmade reservoirs and diversion channels, power lines, and masts undesirable in the landscape. More than 71 percent of tourists (foreign and Icelanders) said they would visit these areas less often if power plant structures were present. The majority of visitors said they would like to see no new structures in the Highlands, keeping the landscape as unspoiled as it is today.

The only structures considered desirable by tourists in the Highlands were mountain huts and rescue huts, marked walking and hiking routes, information signs, and campsites. The survey found that tourists favored improvement of the roads, but that the roads should continue to be gravel roads only suitable for summertime travel. Many visitors agreed that more toilets are needed in the Highlands, as well as improved accommodation options in selected locations. Additionally, over 90 percent of all foreign tourists surveyed favor the establishment of a national park in the Central Highlands.

If one million tourists visiting Iceland in the coming years are an accurate projection, protecting the Highlands from tourist traffic also becomes a major consideration. Increased road traffic, lodging, waste disposal, and protection of the fragile vegetation become critical issues in preserving the unspoiled beauty of the Central Highlands.

Earth Systems Science Approach to Wilderness Protection

The decisions now facing the Icelandic government are complex and will have consequences reaching far into the future. It is perhaps unreasonable to expect that no power plants will be built in the Central Highlands in the near future. The matter then becomes how best to proceed to protect and preserve as much wilderness as feasible, particularly those areas with the highest ecological, biological, and geological protective values. On the other hand, there is a carrying capacity of the land that has to be established and not exceeded, regardless of the number of tourists who want to visit the Central Highlands. Environmental impacts from perhaps hundreds of thousands of tourists, concentrated both seasonally and geographically, will be severe if not properly mitigated. Currently, infrastructure is not in place to receive the projected numbers of tourists in the years to come.

So, how should we proceed? For the proper perspective, we need to more fully understand the sensitive subarctic environment of the Central Highlands. We need to understand how the various natural processes and anthropogenic effects taking place in the Central Highlands, on Iceland's lowlands, and in coastal zones are interrelated. The Earth's systems—the geosphere, hydrosphere, biosphere, and atmosphere—are all interrelated, with continual exchange between systems and subsystems. Changes in one system can have unexpected and sometimes detrimental effects in other systems. Detailed and systematic analyses in the fields of biology and ecology, geology and geophysics, geography, hydrology, meteorology, and climatology have to be carried out, then interrelated to develop a clear picture of the long-term impacts to the entire system that would be affected by both large-scale energy resource utilization and ecotourism.

Significant contributions to this end were made with the Regional Plan for the Central Highlands (1999), the Master Plan for Hydro and Geothermal Energy

Resources, and the study done by the Institute of Natural History on the protective value of various habitat types in the Central Highlands (Einarsson and others 2000).

It is vital to understand what it is we are actually protecting, assigning protective values in much the same way we assign monetary values. Knowing what we know now about what can happen when entire systems are not fully understood, it is unadvisable to make decisions about developing Iceland's power potential without all the facts in place, paying the environmental consequences 20 years from now. Time must be given to the scientists to evaluate the issues using an Earth systems science approach.

The Environmental Research Institute at the University of Iceland in Reykjavik is currently working on ways to bring scientists of all disciplines from all over the world together, with the formation of an International Center for the Environment (ICE), to jointly analyze critical environmental issues such as what Iceland is now facing in the Central Highlands. Iceland's struggle with preservation of wilderness versus energy utilization is not unique. It is vital to open up a consistent forum for the exchange of ideas and research results. The ICE would make it much easier to develop opportunities for international research cooperation on interdisciplinary environmental projects. Scientific results produced in this way will give members of governments the most complete and reliable scientific information necessary to formulate policies and minimize detrimental effects to the environment.

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