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## **The Electricity Supply Industry in Iceland**

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## Introduction

In this paper an overview is given of recent developments in the electricity sector in Iceland, where a new electricity law is being prepared, *inter alia* because of the 1996 EU directive on an inner market for electricity.

The electricity system of Iceland is in many ways different from the large systems of other European countries or the North-American continent. It is small, generation comes from largely from hydro sources and to some extent from geothermal sources, it is geographically isolated, and the majority of demand is from energy intensive firms (mostly aluminium producers) with long-term contracts. The share of energy intensive industry in electrical energy consumption is at present 60% and over the next decades the growth in electricity demand will come from this sector to an overwhelming degree, unless a cable connection with Europe is established.

A characteristic shared with many other countries prior to deregulation is the large involvement of government in the electricity supply industry in general and in particular the preeminence of the current governmentally owned monopoly in generation. Due to past history the current costs of the monopoly are higher than the long-term marginal cost of many possible new projects. At present there does not appear to be political willingness to split the generation part of the company into two or more parts, as seems inevitable if benefits of competition are to be reaped by traditional means.

These characteristics imply that the implementation of the 1996 EU directive and further de/reregulation along the lines of the Scandinavian electricity market, say, must be carefully considered in the preparation of the new law. An important question is whether it is worth setting up the rather elaborate market structure of larger systems where generation, transmission, distribution and sales are separated and a spot market established to ensure short term balance in the market, or whether a simpler design suffices. A potentially fruitful way of tackling this issue is to utilise the technical characteristics of the energy sources, especially the possibility of observing the exercise of market power in hydro systems. In a hydro system with relatively few dams it may be possible to achieve efficient utilisation of the energy resources by contractual means - i.e. by splitting stored electricity (water) in dams up by forward contracts rather than by splitting up the generation company itself.

## The Icelandic electricity sector

### *Supply side*

#### Technologies and size

Most of the electricity generated in Iceland, which in 1998 was approximately 6.3 TWh, comes from hydro power stations, or about 90%. The rest comes almost exclusively from geothermal sources. Total power available in 1998 was 1,213 MW. The unit cost of hydro power from medium sized or large plants is lower than that of geothermal power when the latter is generated through dedicated facilities, but economies of scale are much smaller in geothermal power stations. Hence rather small geothermal plants can be built without unit costs being substantially in excess of those in much larger hydro plants.<sup>1</sup>

Typically, a hydro project of 100-200 MW, say, is built with most of the energy sold in advance through long-term contracts to energy intensive industries. Hence, the “general market” (i.e. the market exclusive of energy intensive industry), which grows by about 10MW per annum on average, can benefit from the economies of scale in a project which without energy intensive industry would provide 10-20 years worth of demand growth. A typical geothermal project of 30 MW may, however, be an efficient way of providing energy to the general market in periods when there are no foreseeable energy intensive projects.<sup>2</sup>

Hydro and geothermal energy are similar from an economic point of view in that variable costs of production are very low for both technologies. The main difference (again, from an economic point of view), between the technologies is caused by the seasonal (predictable) and annual (non-predictable) variability in inflow of water to reservoirs. Geothermal power has no such inherent variability. The exploitation of a geothermal site is simply an extraction problem with a planning period of

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<sup>1</sup> Geothermal energy is used for heating most houses in Iceland through district heating and a limited amount of electricity can be produced at very low cost as a byproduct in high-heat areas.

<sup>2</sup> See Sturluson (1998) for costs of different technologies.

approximately 25 years and in a competitive market where prices are taken as given it will pay to run generation at full capacity throughout the utilization period.<sup>3</sup>

Electricity generation from fossil fuel was only 0.06% of total generation in 1998. However, there are many fuel driven power plants available for reserve generation which in total account for 10% of available power.

The market has grown strongly in recent years. Expected consumption of electricity in the year 2000 is almost 8 TWh, up from 5 TWh in 1995. This is mostly due to growth in sales to energy intensive industry, since the general market is expected to grow by a mere 0.35 TWh over the same period.

There is no connection with other electricity systems at present. Feasibility studies have been conducted for a cable link with Scotland which indicate that such a connection is technically feasible and may be financially viable in the first two decades of the next millennium.

### Current organization

The supply side of the Icelandic electricity sector is at present characterized by vertically integrated - countrywide or local - publicly owned monopolies.

Generation and transmission is dominated by the virtual monopoly of the National Power Company (NPC). The NPC is owned by the Icelandic state, the capital city of Reykjavik and the town of Akureyri and produces about 93% of total electricity generated.<sup>4</sup> The NPC has two main types of customers: the energy intensive firms, which buy their electricity exclusively from the NPC, and vertically integrated distributors/sellers. The NPC is not engaged in retail sales. Distributors are usually owned by municipalities and handle distribution and sales with exclusive concessions in defined areas. Quite often district heating and even cold water supply are horizontally integrated within the same company in a given municipality. An intermediate case is a state owned company, Iceland State Electricity, which generates some electricity (143 GWh in 1998), owns some transmission lines, supplies some municipal distributors with electricity and also sells electricity to (mainly) rural

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<sup>3</sup> Of course this is an oversimplification. The lifetimes of geothermal sites are not known with certainty and risks are certainly present, e.g. due to shifts in the ground where holes are drilled for steam as well as volcanic eruptions in high-heat areas.

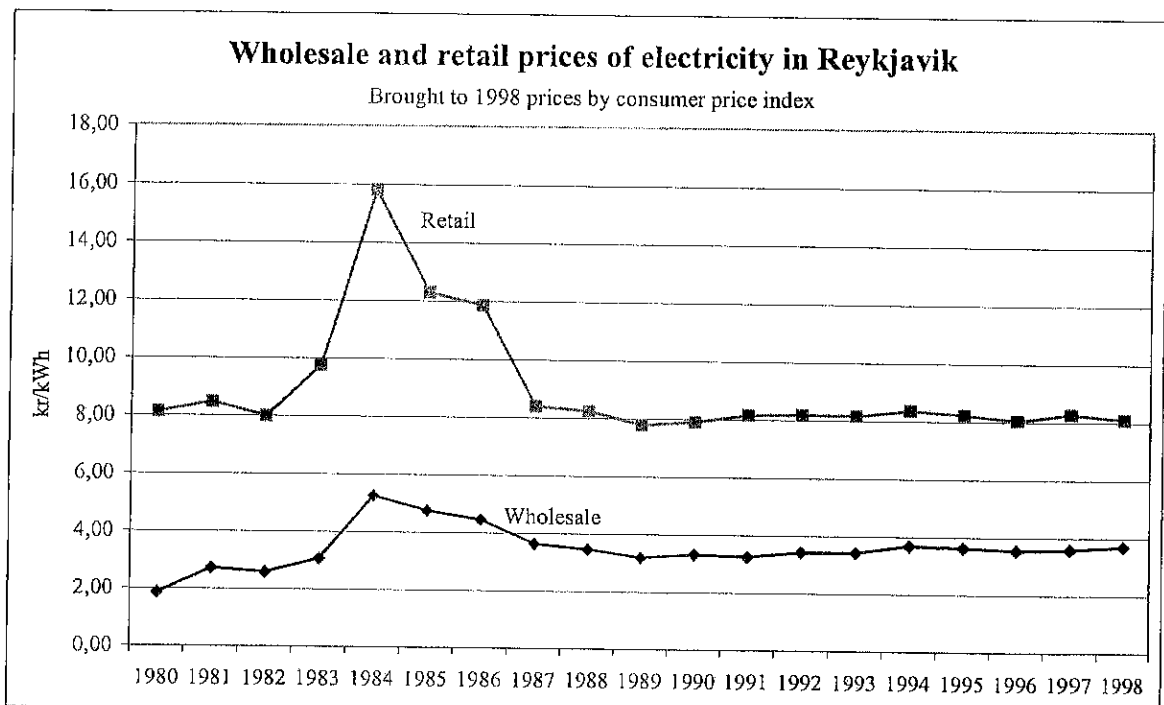
<sup>4</sup> In accordance with the ownership structure, the board of the NPC is politically appointed.

customers (total sales in 1998 were 1.1 TWh of the 2.5 TWh consumed by the general market).

None of the firms in the sector are corporations and they are all under strong political influence. Clearly this restricts them in many ways, *inter alia* by prohibiting them from raising venture capital and they rely on the state or the relevant municipality for backing their loans.

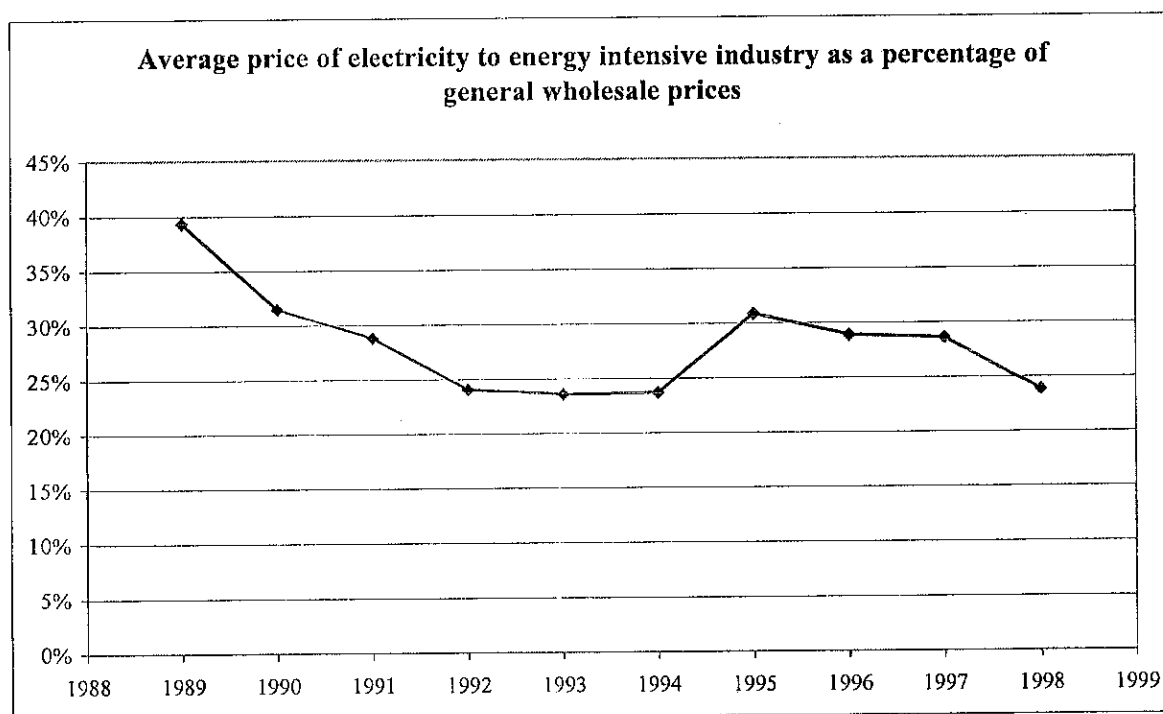
### Pricing

Pricing of electricity to the general market has historically been strongly influenced by the NPC, which governs the wholesale market and is by law obligated to supply distributors with electricity at a uniform price. The goal of the NPC's pricing, by law, is to achieve a "normal" return to invested capital. Until recently the wholesale price from the NPC was regulated by the National Economic Institute (a semi-independent government institute) but at present it is regulated by the Icelandic Competition Authority. New electricity contracts with energy intensive industry (single customers which consume over 100 GWh/annum), which are negotiated separately for each project and are not formally connected to the general wholesale price, must be approved by the minister of industry and trade who also handles energy issues. The law states that such contracts are not allowed to lead to higher prices to the general market.



A rather coarse attempt is made at pricing lower at the margin when there is excess supply of electricity due to large inflows of water to dams. The average wholesale price of electricity in 1998 was 3.7 kr/kWh or 0.053 USD/kWh.<sup>5</sup> So-called “Non-secured” electricity is priced considerably lower or at three different levels ranging from 0.71 to 1.75 ISK/kWh (0.01-0.025 USD/kWh); the actual price the NPC uses depending on the amount of “excess” energy available.

A stated objective of the NPC is to lower the wholesale price of electricity in real terms by 3% per annum in the years 2001-2010. The average price to energy intensive industries (which is strongly tied to the world market price of aluminium) has been less than 30% of the general wholesale price on average over the last 10 years (see Fig. x). Inevitably, this has led to doubts being voiced about the success of projects tied to sales to energy intensive industry and adherence to the letter of the law on cross-subsidization referred to above.



Energy intensive industry also buys non-secured electricity which now is up to about 10% of the firms’ total consumption, but the price is the same as for secured electricity. The firms therefore have no incentives to reduce their consumption of such

<sup>5</sup> This is an average. The actual tariff is more complex, with both power and energy components.



energy and reducing energy delivery to them is first and foremost a last recourse for the NPC in dry years. This is also reflected in the tariff of unsecured electricity to the general market where two levels of three are now higher than the average price to energy intensive industry.<sup>6</sup>

General electricity prices in Iceland are at midrange in the group of OECD countries, and in countries with hydro-based systems such as Norway and New Zealand household prices are considerably lower. Yet, the NPC appears to be competitive in the world market for sales to energy intensive industry since several new contracts have recently been made or are being negotiated. This is very likely because in the more-or-less captive general market the firm has tried to recapture costs resulting from ill-timed investments in the past whereas new price contracts with energy intensive industry are based on long-term marginal costs.

The role of distribution and sales in final prices must also be remembered. The “share” of wholesale prices in retail prices (exclusive of VAT) to households has been steady at 40-45% (i.e. a markup of 130%) since 1987 after rising from approximately 25% in the late 1970s.

### Role of the government

The government plays a central role in the current organization of the Icelandic ESI. Apart from the ownership structure outlined above, the government must approve all investments in new electricity capacity of 0.2 MW or more and usually such approval has not been granted except with the implicit consent of the NPC. At the distribution level the municipalities have the first exclusive right to distribution and sales to their own inhabitants and if a municipality decides not to take advantage of this right the Iceland State Electricity comes next in line. Along with monopoly concessions come obligations to supply electricity to customers in the relevant area.

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<sup>6</sup> Prices to energy intensive firms vary across firms and years. Thus, because of low water supply in reservoirs, supply was recently reduced to a firm which steadily had bought a large amount of its electricity consumption as “unsecured” since 1980. A renewed contract with the firm, in which the Icelandic state until recently had a majority holding, brings the firm more into line with other firms in the sector, thus eliminating the implicit subsidy.

## Public criticism of the current regime

The above description is one of a government dominated ESI similar to those present in most countries prior to the wave of deregulation and liberalization of electricity systems that has swept through the world in recent years. In many ways this system has served Iceland well. Technically, the system is excellent and security of delivery is high. Yet, as may be expected, the system has been criticised from many directions. The most valid criticism is probably based on the fact that, by the NPC's own estimates, the wholesale price of electricity to the general market is about 50% over long-term marginal cost.<sup>7</sup> Some distributors, e.g. with access to geothermal energy, have also criticised the restriction on their investments in new power plants. However, in discussions many of these seem to assume that while generation should be deregulated, sales should not be and they should keep their concessions and produce for "their" market.<sup>8</sup>

## ***Demand side***

### Energy intensive industry

The demand side of the Icelandic electricity sector is strongly characterised by the leading role of energy intensive industry, which to a large degree consists of aluminium producers. At present the firms that comprise this sector purchase over 60% of all electricity energy generated in Iceland and this ratio has fluctuated around 50% since 1970. In economic terms the share of energy intensive industry is much smaller. For example, 66% of the revenues of the NPC in 1998 came from the general market which only purchased 38% of the energy generated by the firm. In 1996 final sales of electricity amounted to 11.2 billion ISK in total while sales to energy intensive industry, which in volume terms were 50% of total consumption, were 2.4 billion, or 22% of total sales.

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<sup>7</sup> The firm claims this is essentially due to politically influenced decisions in the past which caused losses which the firm must recover by law.

<sup>8</sup> This is probably not unique to Iceland; Joskow (1998, p.12) comments on the US market: "[M]uch of the pressure for reform in the United States reflects rent-seeking behavior by various interest groups pursuing private agendas that may not always be consistent with efficiency goals".

With the realisation of current plans for a new aluminium smelter with a capacity of up to 480,000 tpa, the volume share of energy intensive industry could easily rise to almost 80%. The energy intensive firms buy most of their electricity through long-term contracts and in many cases there are dedicated lines for transmission of electricity directly from power stations to the processing facility.

### General Market

In the general market which accounts for the remaining 40% of demand, residential use is approximately 25% or 10% of the total market in terms of electricity energy consumption, with the rest consumed by industries such as manufacturing, services etc. As may be expected, the load profile of the general market is somewhat different from that of the energy intensive industry, there the division is approximately 50:50.

### Interplay of the general market and energy intensive industry

As mentioned above, criticisms have been voiced on the large difference between the general wholesale electricity prices and prices to energy intensive industry. This uneasy cohabitation between the two markets is bound to become worse in coming years with the increasing share of energy intensive industry in electricity consumption. The most important reason for this is the nature of the price contracts with energy intensive industry where prices are tied to the output price of the firms. Thus, in the case of aluminium production fluctuations in the LME price of aluminium translate directly into fluctuations in the price of electricity to aluminium producers. Looking at the price series for aluminium reveals the fact that, as for most other raw metals, it is characterized by high peaks with long troughs in between. The recessions in the aluminium industry, which lead directly to reduced revenues of the NPC, can be several years long. The temptation to try and recapture some of the losses in the general market is obvious and, in the case of permanent price reductions of aluminum, it is almost inevitable that this would be the result under the current regime, if not for anything else than the law on the NPC.

The price risk that the general market implicitly takes on in this way will only be strengthened because of the trend towards a marginalization of the general market, viz. the steadily increasing share of energy intensive industry in energy consumption.

One consequence of this trend are variations in the generation capacity of the hydro system which can fluctuate up or down from the average by 10-15%, depending

on variations in inflow to reservoirs. Even if approximately 10% of the electricity bought by energy intensive industry is interruptible, which implies that energy delivery can be reduced in dry years, this still leads to a glut of energy in years with higher than average inflow because energy intensive firms have no short term ways of using more electricity in an effective way. At present a 10% rise in total supply from that of an average year therefore implies a 25% increase in electricity supply to the general market. In a decade or so when the general market share may become only 20% the increase would be 50%. With normal demand elasticities, such variations will translate into enormous price fluctuations in a competitive market.

### **Recent changes in policy**

In recent years it has become clear that changes in energy policy and in particular electricity policy are needed, *inter alia* because of the 1996 EU directive on an inner market for electricity. Because of Iceland's membership in the European Economic Area, the directive implies that certain changes in Icelandic law on electricity must be made (more on particulars later). In 1996, when the preparation of the directive was in its final stages the Minister of Industry and Commerce established two committees, one composed of owner representatives of the NPC which should form a policy on the future of the NPC and another composed of politicians and representatives of interested parties which should advise the minister on future policy and structure for the energy sector as a whole.

The former committee (NPC-committee) basically recommended that the status quo would be maintained whereas the latter (the Energy committee) recommended that policy be changed with the aim of establishing a more competitive electricity market.

In line with recent international developments, the Energy committee recommended that potentially competitive activities (generation and sales) would be separated from what are still widely regarded as natural monopoly activities (transmission and distribution); that generation would be gradually liberalized; that a separate firm would be formed around transmission activities; that exclusive sales concessions of distributors in their respective areas would be gradually removed and that sales would be gradually liberalized. All these recommendations are more or less in line with recent international developments, e.g. in Scandinavia. A somewhat

special recommendation, but one that with some hindsight should not be surprising, is that new major projects in the energy field, e.g. in connection with energy intensive industry, should be project-financed in such a way that the Icelandic state or the NPC would not bear financial risk due to such investments.

When this is written a bill for a new electricity law is in preparation which will at a minimum have to fulfill the EU directive. However, it is unclear whether further steps to promote transparency and competition in the electricity market will be taken with the new bill.

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