ICELAND ENERGY
FORECAST COMMITTEE

ELECTRICITY FORECAST
1981 - 2000

REYKJAVIK
APRIL 1981

ICELAND ENERGY
FORECAST COMMITTEE

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Apríl 1981

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ELECTRICITY FORECAST BY THE ENERGY FORECAST COMMITTEE ISSUED APRIL 1981

PREFACE

The Electricity Forecast which is presented here constitutes a complete revision of the Electricity Forecast 1977-2000 issued by the Energy Forecast Committee in July 1978 which was an updated revision of The Forecast issued in February 1977.

This revised forecast is not only a recalculated forecast based on updated historical figures, but also includes a revision of all our previous assumptions on future development.

The newest manpower forecast for the remainder of the century issued by The Economic Development Institute of Iceland and the population forecast from the same institute for the same period have been used.

The allocation of available manpower to the different trades has been done by the Energy Forecast Committee after having received comments from The Economic Department of The Central Bank of Iceland, The Economic Development Institute and The National Economy Institute on a draft sent to them.

The earlier presumptions on the use of electricity per employee in the different trades and its rate of growth have been reviewed and revised and also the development in household use.

Changes have been made on some presumptions in the view of past years experience, new aspects in use of energy and latest electricity forecasts from the neighbouring countries.

Some of these changes comprise more energy conservation than before anticipated. The forecast on electrical space heating is based on the committees new forecast (Dec. 1980) of space heating in Iceland till year 2000, and its division between different kinds of energy, but there it is assumed that approximately 80 % of the heated space in the country will be heated by geothermal heat, and approximately 20% will be heated by electricity in the future and that this goal will be achieved mainly in the next few years.

The forecast is based on the minimum rate of economic development in this country which can be regarded as acceptable by the nation.

The forecast does not cover any arrangement to make use of hydro power or geothermal heat for electricity production for new power consuming industry beyond what may be necessary to secure the before mentioned minimum level of economical progress.

A power consuming industry in excess of this is regarded as a political issue on which the Government has not yet made any decisive and therefore, not regarded as ripe for including this forecast.

The presumptions on which the forecast is based are described in more detail later in this report.

2 MAIN CONCLUSIONS AND CHANGES FROM EARLIER FORECASTS

The main conclusion of the Electricity Forecast is that demand for electricity in the future will be in the range which is shown hereunder, depending on how much energy consuming industry is regarded necessary to secure the economical progress which the nation demands.

The following figures show electricity produced in the plants (i.e. including losses).

1985	3904 to 4400 GWh/a and	634 to 795 MW
1990	4514 to 5500 GWh/a and	755 to 880 MW
1995	5161 to 7500 GWh/a and	884 to 1175 MW
2000	5925 to 9650 GWh/a and	1036 to 1500 MW

The lower level of this range is at the turn of the century a little less than 5% below the forecast from 1978, which is a minor difference, considering all the changes made in our assumptions (a.o. at present it is calculated that the population in Iceland will be 282,256 in year 2000 but 293,784 in earlier forecast).

This minor change in the total picture, however, includes much larger differences between the forecasts for the individual groups of users. Thus the requirement for electricity in general household is forecast 30% less in the year 2000 in this forecast than in the latest, but for industry approximately 21% more, and then no new energy intensive industry is included; electricity requirement of service groups is about 35% lower in the new forecast and electrical space heating 5% less.

Reduction in household use and commercial use stems partly from reduced population increase and partly from more efficient use of energy. The increase in industry stems mostly from the fact that an increased number of people is estimated to work in industry compared to earlier forecasts, but fewer in agriculture, fishing and fishindustry. The number of workers in industry will increase, although the total workforce is estimated to be smaller in the new forecast (because of lower population forecast) Industry is now allocated a larger share in the total manpower especially because of the limits which the size of the fishstocks imposes on the number of jobs available in fishing and fishindustry. Also, a foreseeable technical evolution, including computerization will result in a reduction in number of jobs. Limited market for farm products and continous mechanization on the farms will lead to a reduction in the number of farmers.

If one is to secure productivity and prosperity in these occupations which is prerequisite for more service participation, it is evident that the industry must absorb the manpower increase of the production occupations in the future.

Increased flow of workers seeking employment in industry, which is the accepted view, makes it more acute than before to answer the question whether industry can absorb all increase in manpower, or if a new energy consuming industry must be provided to absorb a part of it. This question is specially important from the electricity forecasting point of view, as the use of electricity per worker can be hundredfold in an energy consuming industry as compared to light industry.

After a thorough reflection and after receiving the aforementioned comments, it was the conclusion of the Energy Forecasting Committee that no definite answer exists at this moment.

The Committee decided to forecast upper and lower limits for the use of electricity in industry, rather than one definite trend.

These limits are intended to reflect the uncertainty, which exists in the committee´s judgement in the requirement for electricity in the industrial sector in the future as a result of the manpower it is supposed to absorb, assuming the productivity and the multiplying effect on the service sectors, which are prerequisites for economical evolution (see chapter 4.1).

The upper limit reflects the idea that three quarters of the manpower increase will be in general industry, but one quarter in new energy consuming industry. The committee regards it as likely that the real requirement for electricity in the future lies between these limits.

The lower limit of electricity use in industry reflects the idea that the general industry can absorb all increase in manpower in industry all the way till the year 2000, and that no further increase will be in energy consuming industry.

The committee emphasizes that the forecast does not include electricity requirement of new industrial enterprise which the Government may decide to start in excess of what is necessary in order to fulfill the economical presumptions of the forecast.

For nonindustrial uses, only one forecast is made.

The Electricity Forecast in its entirety varies whithin an interval which has the same width as the interval in the forecast for the industry.

The limits of this interval will hereafter be called "upper forecast" and "lower forecast".

As can be seen by the figures given above, the interval between the upper and lower limits of the electricity forecast is approximately 3.7 TWh/a at the turn of the century.

The Energy Forecast Committee regards it as most advantageous to use the Electricity Forecast in such a way that the research and preparations for power projects be focused on the upper forecast, but they could be slowed if the trend is below the upper forecast.

ELECTRICITY FORECAST 1981 - 2000

TABLES AND DIAGRAMS

SURVEY OF ELECTRICITY FORECAST DEVELOPMENT

Primary Energy in GWh

FORECASTED ELECTRICITY REQUIREMENT FOR THE WHOLE COUNTRY

Year	First Forecast 1976-2000	Present Forecast 1981-2000	
		Lower	Higher
1980	3436	3130*	3130*
1985	4110	3904	4400
1990	4767	4514	5500
1995	5505	5161	7500
2000	6370	5925	9650

* Actual figures.

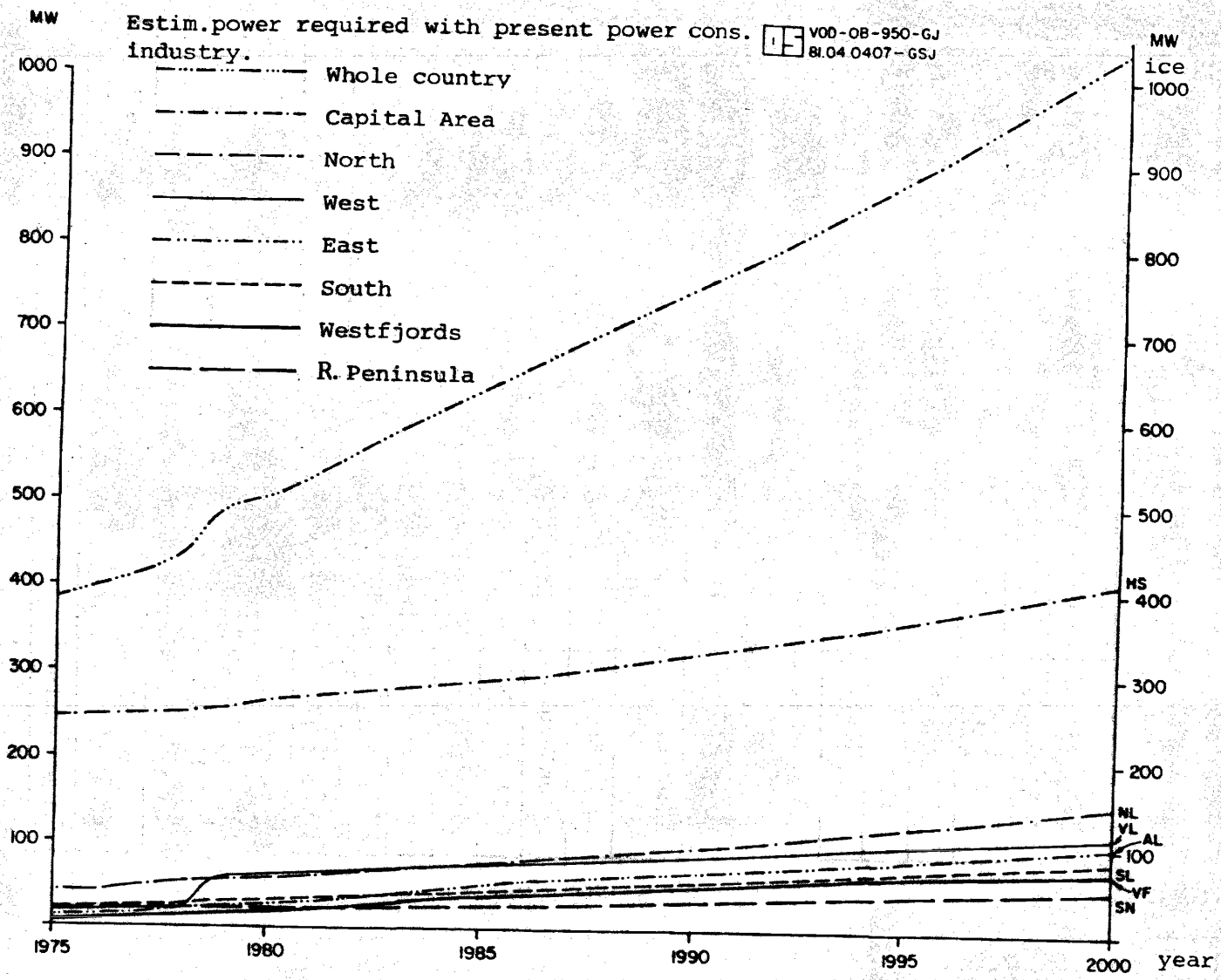
ELECTRICITY REQUIREMENT BY AREAS, NO POWER CONSUMING INDUSTRY.

Areas	1980	1990	2000
South	153	282	426
S.Peninsula	129	188	283
Capital Area	459	749	1190
West	140	272	407
Vestfjords	90	265	370
North	284	485	750
East	130	344	504

ELECTRICITY REQUIREMENT BY KIND OF USE IN YEAR 2000

Kind of Use	Forecast 1976-2000	Forec.1981-2000 Lower	Forec.1981-2000 Higher
Space heating	1206	1115	1115
Household	995	626	626
Commerce	482	306	306
Industry	979	1206	1130
Other	300	257	257
Power consuming	1705	1717	5340
Losses	743	698	876

ESTIMATED POWER REQUIREMENT



3.3.1

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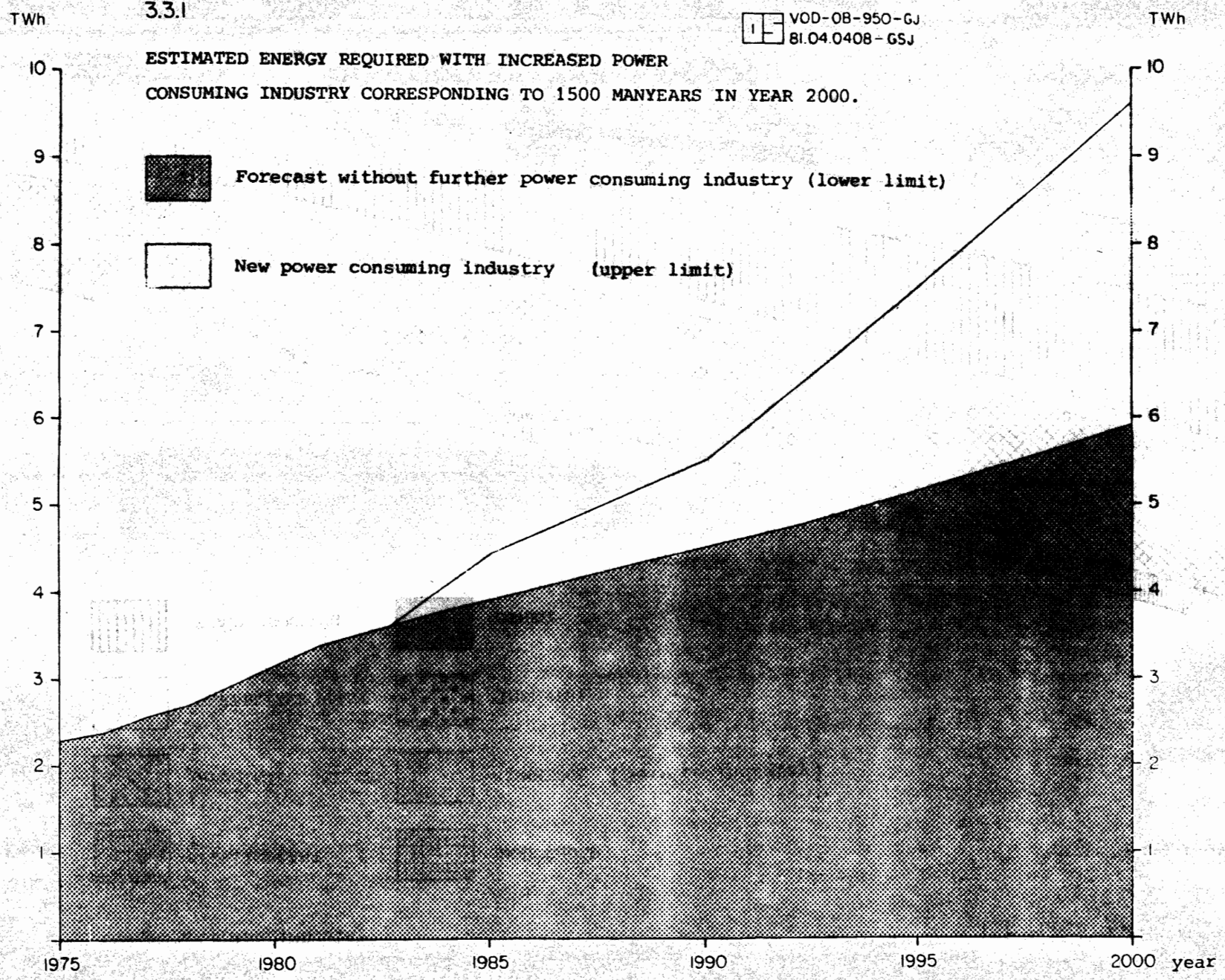
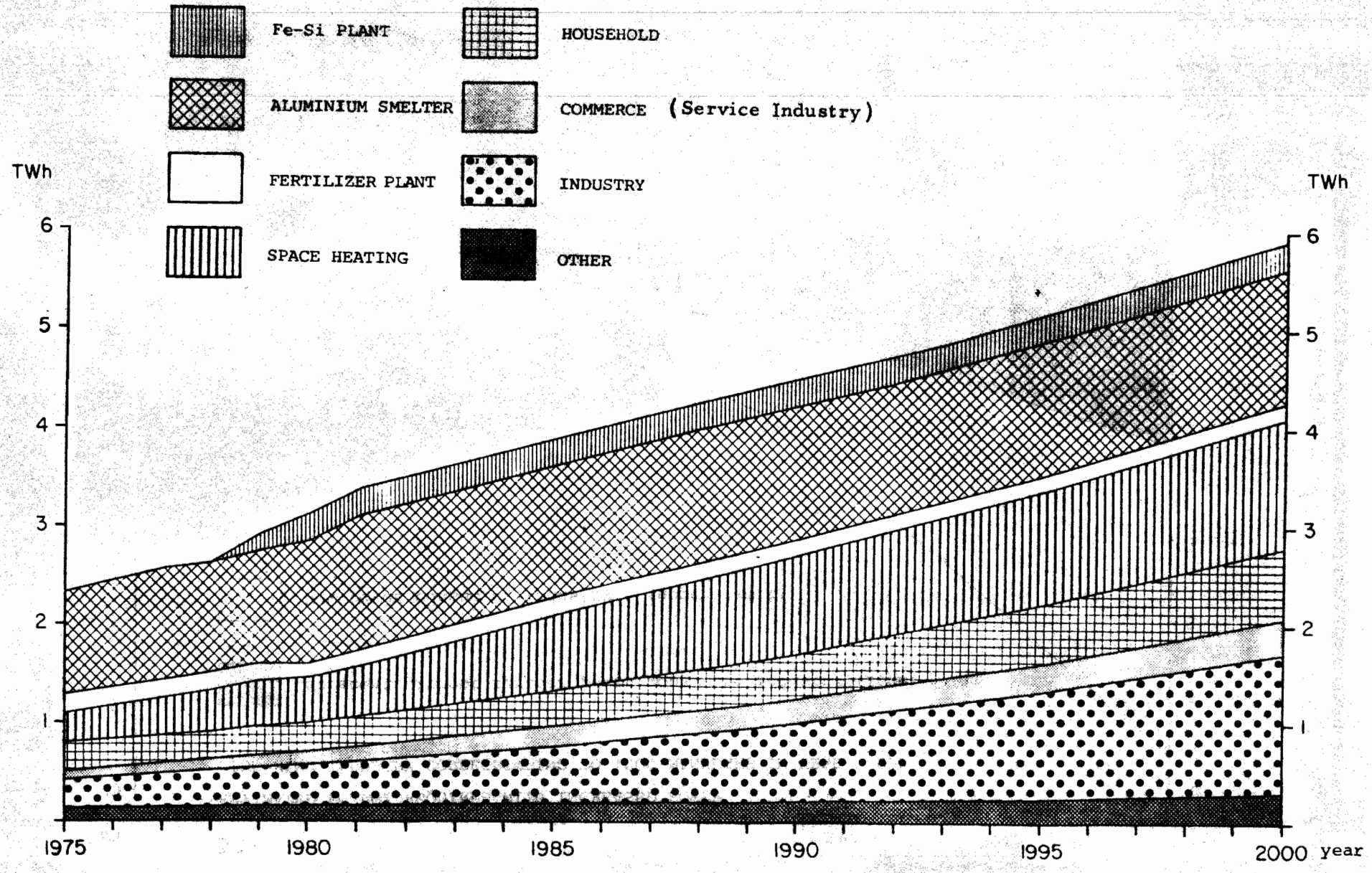
81.04.0408-GSJ



3.3.2 ESTIMATED ELECTRICITY REQUIREMENT WITHOUT FURTHER POWER CONSUMING INDUSTRY.



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ESTIMATED ELECTRICITY CONSUMPTION

TABLE 3.4.1

AREA IS ICELAND

YEAR	Population	DOMESTIC SPACE HEATING GWh	DOMESTIC GWh	COMMERCE GWh	INDUSTRY GWh	OTHER GWh	ENERGY SALE GWh	DISTRIB. LOSSES GWh	ENERGY PURCHASE GWh	IN-CREASE %	DEMAND MW
* 1975	219033	246	222	82	238	113	902	115	1017	-	201
* 1976	220918	277	225	83	257	116	959	123	1082	6.4	214
* 1977	222470	304	227	91	283	121	1025	134	1159	7.1	229
* 1978	224384	355	238	98	310	127	1129	149	1278	10.2	253
* 1979	226724	398	249	106	342	121	1216	157	1373	7.4	272
* 1980	228769	390	252	108	352	133	1236	150	1386	0.9	274
1981	231648	439	271	115	379	137	1342	165	1507	8.7	298
1982	234150	498	285	122	405	142	1452	180	1631	8.3	323
1983	236667	555	298	129	432	147	1562	195	1756	7.7	348
1984	239201	608	313	136	461	153	1671	209	1881	7.1	373
1985	241750	659	328	144	492	158	1781	223	2004	6.6	397
1986	244314	705	343	151	524	164	1888	237	2125	6.0	422
1987	246894	745	360	160	559	170	1993	250	2243	5.6	445
1988	249490	780	376	168	595	176	2096	262	2358	5.1	468
1989	252100	812	394	177	633	182	2198	274	2472	4.8	490
1990	254726	840	411	187	673	188	2299	286	2585	4.6	513
1991	257368	866	430	197	715	194	2403	297	2700	4.4	536
1992	260024	893	449	207	760	201	2509	310	2819	4.4	559
1993	262695	920	469	218	807	207	2620	322	2942	4.4	584
1994	265382	947	489	229	856	214	2735	335	3070	4.3	609
1995	268083	974	510	241	907	221	2854	348	3202	4.3	635
1996	270799	1002	532	253	962	228	2976	362	3338	4.3	662
1997	273529	1030	554	265	1018	235	3103	376	3479	4.2	690
1998	276274	1058	578	278	1078	242	3234	390	3624	4.2	719
1999	279034	1086	601	292	1141	250	3370	405	3775	4.1	749
2000	281807	1115	626	306	1206	257	3510	420	3930	4.1	780

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ESTIMATED ORDINARY ENERGY WITH PC INDUSTRY

TABLE 3.4.2

AREA IS ICELAND

	ORDINARY ENERGY USE		FERTILIZER PLANT		ALUMINIUM SMELTER		Fe-Si PLANT		TRANSM.LOSSES		TOTAL PRODUCTION	
	ENERGY GWh	DEMAND MW	ENERGY GWh	DEMAND MW	ENERGY GWH	DEMAND MW	ENERGY GWh	DEM. MW	ENERGY GWh	DEMAND MW	ENERGY GWh	DEMAND MW
* 1975	1017	201	134	18	1027	148	0	0	107	18	2286	385
* 1976	1082	214	137	18	1068	148	0	0	113	19	2400	398
* 1977	1159	229	147	18	1147	148	0	0	121	19	2574	414
* 1978	1278	253	149	18	1136	148	0	0	126	21	2689	439
* 1979	1373	272	129	18	1131	148	163	33	138	23	2934	494
* 1980	1386	274	128	18	1209	156	260	33	147	24	3130	505
1981	1507	298	150	18	1307	156	260	33	159	25	3383	530
1982	1631	323	150	18	1307	156	260	33	165	26	3514	557
1983	1756	348	150	18	1307	156	260	33	171	27	3645	583
1984	1881	373	150	18	1307	156	260	33	177	29	3775	609
1985	2004	397	150	18	1307	156	260	33	183	30	3904	634
1986	2125	422	150	18	1307	156	260	33	189	31	4031	660
1987	2243	445	150	18	1307	156	260	33	195	32	4155	684
1988	2358	468	150	18	1307	156	260	33	201	33	4276	708
1989	2472	490	150	18	1307	156	260	33	207	34	4395	732
1990	2585	513	150	18	1307	156	260	33	212	35	4514	755
1991	2700	536	150	18	1307	156	260	33	218	37	4635	779
1992	2819	559	150	18	1307	156	260	33	224	38	4760	804
1993	2942	584	150	18	1307	156	260	33	230	39	4889	830
1994	3070	609	150	18	1307	156	260	33	236	40	5023	856
1995	3202	635	150	18	1307	156	260	33	242	42	5161	884
1996	3338	662	150	18	1307	156	260	33	249	43	5304	912
1997	3479	690	150	18	1307	156	260	33	256	44	5452	942
1998	3624	719	150	18	1307	156	260	33	263	46	5605	972
1999	3775	749	150	18	1307	156	260	33	271	47	5762	1003
2000	3930	780	150	18	1307	156	260	33	278	49	5925	1036

THE PREMISES OF THE FORECAST

4 THE PREMISES OF THE FORECAST

4.1 General

As mentioned in chapter 2, the Energy Forecast Committee bases its forecast on The Economic Development Institute of Iceland´s forecast from 1980 on population until year 2000, and its division between parts of the country and the same institute´s forecast on manpower i.e. the number of people engaged in the various occupations at the corresponding time.

Continued economic growth is reflected in the forecast by an increasing use of energy per worker and may be regarded as a base for the productivity increase which is a necessary foundation of economic progress in the long run.

Approximately the same increase in use of energy per worker is assumed as experienced in this country over the last few years, but at the same time new forecasts from the neighbouring countries are considered.

The effect of energy conservation can be regarded as included in the forecasts for energy use per worker in the occupations and energy use per inhabitant for household.

The Electricity Forecast does not include secondary energy of any kind as it does not influence size and timing of new poer projects. All electricity for space heating is included, whether it is used as direct heat or in district heating.

During the decade 1990-2000 some use of electric vehicles in forecast Their electricity use is included in use of electricity in other occupations; household, commerce and industry as it is not expected that electricity for vehicles will be measured separately.

The electricity forecast includes the committee´s assessment of what will be the demand for electricity at each time if the customers had free choice.

It does not take into consideration that the use will be restricted, neither by direct rationing, other kinds of official bans nor that power plants, transmission and distribution lines limit the load (indirect rationing).

4.2 Electricity for Space Heating

In this forecast it is estimated that primary electricity will replace oil for space heating in scarcely populated areas and in denser populated areas where the possibility of getting geothermal heat is remote today. It is assumed that this electrification of space heating will be completed to a great extent in the next two to four years. In December 1980 the Energy Forecasting Committee issued the report "Space Heating Forecast 1980-2000". In that report it is generally explained what presumptions are used when a forecast is made for space heating.

In this present report the presumptions are somewhat simplified, but care is taken that the results regarding the electricity for space heating conform to that forecast.

For every center of population and also for the sparsely populated areas it is assessed to how great an extent geothermal heat can be used for space heating. Those areas which will not enjoy geothermal heat according to this assessment are considered electrically heated areas, and also those areas where geothermal district heating projects are very uncertain for one reason or another.

The results of this assessment are shown in table 5.2.

Electricity requirement for space heating is in 1980 estimated 12.500 kWh per capita per year. Space per capita has during the past years increased very rapidly, by 3-4% per year according to the Real Estate Assessment Office. In this forecast it is estimated that the electricity use for space heating will increase by 2.5% per capita per year the first year but that this increase will decrease lineally to 1.5% by year 2000. Figure 5.3 shows how this trend has been in Reykjavik from 1961, but there the number of inhabitants per apartment has decreased by 2.3% per year. At the same time the water production of the Reykjavik Geothermal District Heating per inhabitant in the area has increased by 1.9% per year.

The various areas are not equally advanced in the use of electricity for space heating and also the distribution systems are differently prepared to meet increased load from space heating.

Therefore, it is estimated that the various areas will not be completely electrically heated at the same time.

In this forecast it is calculated that electrical space heating will reach 90% of the inhabitants in electrically heated areas in the South, West and North before 1983, but in 1985 in East and Westfjords.

According to this forecast only 4% of heated space will be oil heated after two years.

4.3 Electricity for Household

Household use is now rather evenly distributed or about 1100 kWh/a per capita average for the whole country.

The use is highest in South 1156 kWh but lowest in Westfjords 1042 kWh. In this forecast it is estimated that the use will be two times what it is now in 2000, or 2200 kWh/a per capita. This is a considerably less increase than estimated in earlier forecasts, as soaring energy prices have led to increased emphasis on energy conservation and the production of equipment which uses less energy.

As an example of results in energy saving an ordinary TV set can be taken. Some years ago the power requirement of such an equipment was 300 W but now below 100 W in new sets.

In the Oil Forecast the Energy Forecast Committee estimated that in the year 2000 about 13,600 electric vehicles would be in the country. In this present forecast it is presumed that private vehicles will be charged at home and this consumption is included in this forecast for household.

In 5.4 is shown how household use per capita will develop until the year 2000.

As a comparison are shown forecasts for USA and Sweden.

The USA figures are not completely comparable, because there electricity is used for cooling in the summer, which increases the consumption considerably, but on the other hand gas is widely used for cooking, which decreases electricity consumption.

4.4 Electricity in Commerce and Industry

4.4.1 General

As described earlier the forecast for electricity in commerce and industry is based on population and manpower forecasts made by The Economic Development Institute of Iceland in 1980. The allocation of the manpower on different activities is based on a forecast made by the Comittee subsequent to reviews and remarks made by the Economic Division of the Central Bank, The Economic Institute and The Economic Development Institute. This forecast is as follows:

	1977	1980	1985	1990	1995	2000
Revised manpower forecast until year 2000 (Dec. 1980)						
Farming	8200	7800	7400	6500	6000	5500
Fishing	5200	5100	5000	5000	5000	5000
Fish industry	8600	8500	8500	8500	8500	8500
Building activity	10800	11300	12000	12500	13000	13000
Industry	17000	17900	19400	20900	22400	23900
Commerce	48100	54200	60400	66900	71100	76800
Total	97900	104800	112700	120300	126000	132800

Such manpower forecasts have been made by The Economic Development Institute until 1988, though most detailed till 1983. The Committee has very much relied on them.

The Committee has also used the report "Plan for industrial development". This is a report issued by The Committee for Cooperation in Industrial Development in Reykjavik, May 1979, regarding manpower in industry and its development.

This report discusses in detail the industrial development in the next years, but only covers the time until 1987.

As the Electricity Forecast is intended to cover the time till the year 2000, these manpower and industrial development forecasts mentioned are too short to use as basis for this EF forecast.

With the aid of some employees from The Economical Development Institute the Committee therefore extended those forecasts that existed on manpower and its allocation on activites all the way till the year 2000. This extension was only intended as a working document to be sent to specialists in economy who work on matters connected to employment development and national economy for their comments.

The goal with these comments was to make as sound a foundation as possible for the electricity forecast.

The committee was well aware that no electricity forecast that deserved the name would be made, unless a base existed for the development of individual occupations of which some use much electricity.

The Committee was also aware that such occupational forecasts would not be made without certain presumptions regarding the general economical development compatible with the direction in which economical and occupational activities are headed. No consensus exists on this. Some are f.inst. of the opinion that Icelanders can secure very good standard of living in the future by utilizing the country´s energy sources on a big scale for energy consuming industry. Others hold the opinion that big industry is hazardous, and that a comparatively good result could be obtained with limited energy intensive industry.

The Committee holds the opinion that it is not the right instance to decide in such disputes. Its role is to evaluate expected demand for energy, in this case electricity, which could be instrumental for power projects research and preparation.

It is, of course, the role of government to decide on matters of policy for energy consuming industry among other things.

The present government´s working agreement has the following to say about new industry: "The State will investigate the foundation of major

new industry which a. o. is based on indigenous energy and raw materials, provided that such new industry and further power consuming industry will be under local control.

Even though this paragraph contains a definite declaration of will it is in too general terms to be useable for a forecast on demand for electricity. For that purpose a more definite goalsetting is required and their allocation into time defined periods.

As long as this does not exsists the Committee has regarded it proper to found its work on following presumptions, which may be regarded as a general view.

1. The Icelanders´ standard of living shall not be below that in the other Scandinavian countries. What now may be amiss will be gained during the study period.

2. Living standard will be as equal as possible for the different occupations, i.e. productivity in each occupation will increase so as to secure those occupied there approximately the same conditions as in other occupations. What may be missing shall be gained.

3. Full employment and productive work for all who are able to work will be sought to be maintained.

4. The emigration which has existed for the past years (500-1000 people/year) will be halted.

An electrical forecast based on these presumptions must then be regarded as the lower limit on which research and preparations for new power plants must be based.

Without doubt some will want to aim higher and would not regard it as unsurmountable to reach farther in economical progress in the future f. inst. by means of a considerable increase in energy consuming industry.

If it should be officially decided to increase the rate of the utilization of energy resources for this reason, the resulting increase will have to be added to the electricity forecast.

It is easy to take care of the consequences from this when and if such decisions will be made.

On the above assumptions the Committee drafted a manpower forecast for both individual occupations and the total and sent it to the following institutions for their comments:

The Economic Department of the Central Bank of Iceland.
The National Economical Institute.
The Economical Development Institute of Iceland.

They all gave their comments.

The Economic Department of the Central Bank indicates that the foundation on which the Committee intends to base its forecast and which is described above, is not necessarily the only right one. However, a forecast which is based on the Committee´s foundation has a value as a low forecast.

This conforms to the aim of the Committee which is mentioned earlier.

The remarks of the Economics Department regarding another possible foundation are, of cours, right. But, if an estimated electricity requirement, based on such a foundation, is to have any value as a forecast, i.e. an estimate of real demand for electricity to be expected, which could be used for the timing of projects, the government must first make miscellaneous decisions. This is exactly the reason why the Committee has chosen to base its forecast on low limit presumptions on economic development.

The Economics Department does not make any comments on estimated allocation of manpower to the different occupations in the Committee´s draft. The Economical Institute and the Economical Development Institute on the other hand comment that manpower for farming, fishing and the fish industry is estimated too high in the Committee´s draft. The Committee agrees that these comments should be considered (from the two institutes) and has accordingly reevaluated the manpower in same activities.

The above table reflects the results of this reevaluation.

The manpower in service industries will, accordingly be 76.800 in year 2000 or 57,9% of the total manpower. This ratio is close to example 2 in The Economical Development Institute´s comments, only slightly lower.

It does not, reach the high ratio of service industries in Norway, Denmark and Sweden in 1978 and is still considerably below same in USA and Canada for that year.

Considering received comments two questions become pertinent in conjunction with this reevaluated forecast.

1. Is the manufacturing industry which is included able to support the service industries which supposedly follow.

2. In what way can the manufacturing industry increase its manpower, as the forecast shows (6000 new jobs in 1980 - 2000).

The former question is somewhat discussed in the comments from The Economical Development Institute and the conclusion reached is to presume that not more than 70.000 workers will be in the service sector in year 2000.

The latter question is also discussed in the same comment in connection with the problem, how a sufficient productivity will best be secured in order to support the requirements of the economical development, which the Committee bases its forecast on.

The opinion that "increased productivity seems, for now, most likely, to be found in industrial development, which is founded on the utilization of harnessed energy" is also viewed in that comment.

In the NEI comments it is pointed out that a manpower increase in industry up to 23.900 manyears about the turn of the century is in good agreement with the development during the last decade in general industry (without power consuming industry), but that it is difficult to predict this development for the next decades.

The Economic Department of the Central Bank holds the opinion that "some increase in power consuming industry will be a prerequisite for the industry to absorb the manpower allocated, as well as fulfilling the demand for fast enough technical development.

Of great importance to the estimated electrical requirement is, whether the scheduled increase in manpower in industry will be solely in general industry or partly in energy consuming industry.

This is of great importance because the electricity consumption per manyear is many times greater in energy consuming industry.

That increase in manpower in industry which is included in the revised manpower forecast, equals 300 new jobs each year until year 2000. It is approximately the same increase as has been yearly for the past 15 years or so. The question is, will such an increase be able to continue for the next 20 years, without a part of it being in energy consuming industry, if those requirements for productivity in industry shall be fulfilled which can support the economic growth which the Committee bases its forecast on and the level of service industries which it estimates. From the comments received one can figure that this might be doubtful.

The Committee sees it fit to include this doubt by making two forecasts rather than one.

The first, the lower forecast, assumes that the whole manpower increase in industry can be absorbed by the general industry but that power consuming industry will not increase during the next 20 years. The other, the higher forecast, assumes that three fourth of this increase will be in general industry, but one fourth in energy consuming industry.

The latter presumption means that 225 workers will be added on the average to the manpower in general industry but 75 workers in energy consuming industry; the first means that 300 workers will be added to the general industry, but none to the energy consuming industry. It is estimated that the increase in energy consuming industry will mainly be during the years 1985-2000.

Considering the returned comments, the Committee thinks that somewhere between these two levels could lie the manpower allocation in industry which could secure a minimum basis for economical development, on which to found the electricity forecast.

<u>These two electricity forecasts shall therefore be regarded as two different evaluations of the requirement for electricity which follow these minimum requirements.</u>

The Committee does not find it possible to define these requirements more accurately on the basis of the data available at this stage.

The Committee wants especially to emphasize what was stated just now, that this is a question of two different evaluations of minimum requirements.

The increase in energy consuming industry, which is inherent in the higher forecast is not to be taken as a plan for industry.

If this proves necessary it is only an unavoidable arrangement for fulfilling the demand for an economical development, which nearly everybody agrees on. As long as experience has not proven the point, the evaluation of necessary allocation of manpower to different branches of the industry in order to fulfill the minimum requirements can be disputed, and consequently the electricity demand, resulting from that evaluation. But that dispute is more of a technical or theoretical than of a political nature. It is a question of necessary arrangements in order to achieve a predetermined goal. Such an addition, if proven necessary, is not a political issue, but only the prerequisite of what everybody agrees on. However, the political question rests unanswered, whether a faster economical development in this country should be adopted than which is inherent in the presumptions of the Committee by still further utilization of the energy resources. It is up to those who govern the country to answere that question and the Committee takes no sides.
On the other hand the Committee points out and emphasizes that, because of the long research and preparation time of major hydro electric projects, it is necessary that the government decides on a course in matters of energy consuming industry in good time and makes also statements of will in this matter, and defines specific goals and approximately timed steps.

4.4 General Industry and Services

Two things are considered as to mainly influence electricity consumption in industry and commerce i.e. the number of workers on one hand and increased mechanization, which results in increased use of electricity per worker on the other hand. A research of electricity consumption and manyears in industry from 1960 shows that electricity consumption has increased by 5.3% per year per worker in industry, but corresponding

figure in commerce is 4.2%. It is estimated that this increase will be somewhat reduced in the future and that it will be 4,5% in industry and 3,4% in commerce in the year 2000.

As mentioned earlier the Committee has made a manpower forecast for the whole country and by referring to the forecasts of the Economical Developing Institute also for individual communities.

The total influence of increased manpower in industry and more electricity use per worker amounts to approximately 7% yearly increase in the beginning of the period but 5,8% in the year 2000.

In commerce the same figures amount to 6,0% now but 5,0% in the year 2000. In all energy forecast the Committee foresees saturation in energy requirement when time passes. The above mentioned decrease in the growth of electricity demand in industry and commerce reflects the ideas of the Committee on saturation of the electricity market.

4.5 Energy consuming industry

The Fertilizer Plant

Over the years the power sale to The Fertilizer Plant has been between 130 - 147 GWh/year. This corresponds to a production of 140-157 GWh/year in the Landsvirkjun's power plants.

For different unvoidable reasons power sales have always had to be reduced to the plant. It will be expected that sales to the plants will be 150 GWh/year in the future, which corresponds to 160 GWh in production.

The Aluminium Smelter (ISAL)

The electricity produced for the Smelter is 1370 GWh/year and 164 MW as primary power but in addition not guaranteed power is made available up to 100 GWh/a and 12 MW.

The Ferro-silicon Plant (FJ)

The electricity produced for the Fe-Si plant is 270 GWh/a and 33 MW, and not guaranteed power is of the same order.

4.6 Other consumption

This category includes consumption which is not included in other categories.

The largest units are elctricity sale to the Keflavik Airport and street lighting. It is estimated that the growth in this use will be rather slow or about 4,5 % per year at present and will be reduced to 3% in the year 2000.

4.7 Losses

Losses are figured as the difference between the production of power stations and measured sale to the customer.

In this forecast the losses are handled in a somewhat different way than before in former forecasts, and they are divided in two parts as follows:

1. Main System Losses

   Landsvirkjun´s station service consumption
   Krafla station service consumption
   Transmission losses in Main System.

2. Distribution Losses

   Station service consumption of all other stations
   Transmission losses from Main System or Power station to the customer.

The distribution losses are calculated for each part of the country. The Main System losses are on the other hand not included in the forecasts for each individual part and only appear in the forecast for the whole country.

This method, to split the losses, provides more complete information than if the main system losses were divided between parts.
These losses depend more on the total consumption, location of power stations, and the system layout, rather than the individual locations.

4.8 Maximum demand (MW)

The maximum demand in a power station is estimated according to the forecast using 5000 hours utilization per year as a basis for the ordinary marked and space heating. This utilization time is longer than has been used in the previous forecasts. This is based on a trend noticed during the last years.

TABLES AND DIAGRAMS OF THE FORECAST'S PREMISES

Table 5.2 The division of the Country in geothermally and electrically heated areas

SOUTH

Population 1980, 19628

Geothermally heated		Electrically heated	
Vestmannaeyjar	4009 Ih.	(85% hitaveita)	708 Ih.
Selfoss	3411 "	Vík	370 "
Hveragerði	1254 "	Búrfell	75 "
Þorlákshöfn	1000 "	Írafoss og Ljósifoss	60 "
Stokkseyri + Eyrarbakki	1128 "	Kirkjubæjarklaustur	120 "
Laugarvatn	160 "		
Hvolsvöllur	530 "		
Hella	550 "		
Flúðir	100 "		
Laugarás	91 "		
V-Skaftafellssýsla			858 "
Rangárvallasýsla			2418 "
Árnessýsla	836 "	(30% hitaveita)	1950 "
Hitaveita alls	13069 Ih.	Rafhitun alls	6559 Ih.

33,4% live in electrically heated areas, but it is figured that electrical heating is 34% of all space heating in the South area.

Table 5.2 ctd.

SOUTH PENINSULAS

Population 1980, 13246

Geothermally heated		Electrically heated	
Grindavík	1921 Ih.	Hafnir	141 Ih.
Keflavík	6625 "	Vatnsleysuströnd	110 "
Njarðvík	1992 "		
Sandgerði	1104 "		
Gerðar	903 "		
Vogar	450 "		
Geothermally	12995 Ih.	Electrically	251 Ih.

1,9% lies in electrically heated area, but it is figured that present electrical heating in geothermally heated areas will partly remain and that electrical heating will correspond to 6% of all space heating in the South peninsulas.

CAPITAL AREA

Population 1980, 121353

Geothermally heated		Electrically heated	
Reykjavík	83449 In.		
Kópavogur	13814 "		
Seltjarnarnes	3093 "		
Garðabær	4868 "		
Hafnarfjörður	12221 "		
Mosfellssveit	2944 "		
Kjósarsýsla	482 "	(50% electrically)	482
Geothermally	120871 Ih.	Electrically	482 Ih.

0,4% of inhabitants live in electrically heated areas, but it is figured that electrical heating is 1,5% of all space heating in the capital area.

Table 5.2 ctd. **WEST**

Population 1980, 14840

Geothermally heated		Electrically heated	
Akranes	5170 Ih.	Hellissandur + Rif	616 Ih.
Borgarnes	1615 "	Ólafsvík	1180 "
Hvanneyri	110 "	Grundarfjörður	685 "
Kleppjárnsreykir	48 "	Stykkishólmur	1169 "
Reykholt	68 "	Búðardalur	310 "
Borgarfjarðarsýsla	612 "	(50% geothermal)	613 "
Mýrasýsla	92 "	(10% ")	826 "
Snæfellssýsla	56 "	(6% ")	875 "
Dalasýsla	48 "	(6% ")	747 "
Geothermally	7819 Ih.	Electrically	7021 Ih.

47,3% lies in electrically heated area, but it is figured that present electrical heating in geothermally heated areas will remain in part and that electrical heating will correspond to 49% of all space heating in West areas.

Table 5.2 ctd. NORTH

Population 1980, 36357

Geothermally heated		Electrically heated	
Sauðárkrókur	2166 Ih.	Skagaströnd	644 Ih.
Siglufjörður	2005 "	Hofsós	304 "
Ólafsfjörður	1191 "	Litli Árskógssandur	71 "
Dalvík	1272 "	Hauganes	106 "
Akureyri	13408 "	Hjalteyri	56 "
Húsavík	2411 "	Svalbarðseyri	120 "
Laugabakki	95 "	Grenivík	286 "
Hvammstangi	588 "	Kópasker	185 "
Blönduós	923 "	Raufarhöfn	501 "
Varmahlíð	95 "	Þórshöfn	442 "
Hrísey	285 "		
Reykjahlíð	233 "		
Laugar	102 "		
V-Húnavatnssýsla	181 "	(20% geothermally)	722 "
A-Húnavatnssýsla	201 "	(20% ")	802 "
Skagafjarðarsýsla	386 "	(20% ")	1545 "
Eyjafjarðarsýsla	408 "	(20% ")	1630 "
S-Þingeyjarsýsla	894 "	(40% ")	1340 "
N-Þingeyjarsýsla	-		655 "
Geothermally	26844 Ih.	Electrically	9409 Ih.
		Grímsey	104 "

25,9% of inhabitants in North are figured to live in electrically heated areas, but in addition it is estimated that some electrical heating will remain in geothermal areas f. inst. in Akureyri.

A total of 28% of the inhabitants is estimated to use electrical space heating.

Table 5.2 ctd. **WESTFJÖRDS**

Population 1980, 10446

Geothermally heated		Electrically heated	
Reykhólar	90 Ih.	Ísafjörður	3337 Ih.
Suðureyri	501 "	Bolungarvík	1247 "
		Patreksfjörður	1035 "
		Tálknafjörður	280 "
		Bíldudalur	346 "
		Þingeyri	420 "
		Flateyri	453 "
		Súðavík	230 "
		Hólmavík	390 "
		Drangsnes	116 "
Barðastrandarsýslur	22 "	(3% geotherm)	664 "
V-Ísafjarðarsýsla	-		332 "
N-Ísafjarðarsýsla	28 "	(10% geotherm)	253 "
Strandasýsla	40 "	(6% geotherm)	630 "
Geothermally	681 Ih.	Electrically	9733 Ih.
		Flatey	32 "

93,2% of inhabitants are at present considered to live in electrically heated areas. It is figured that 90% will have electrical heating in the future. Flatey will not be electrically heated.

Table 5.2 ctd.

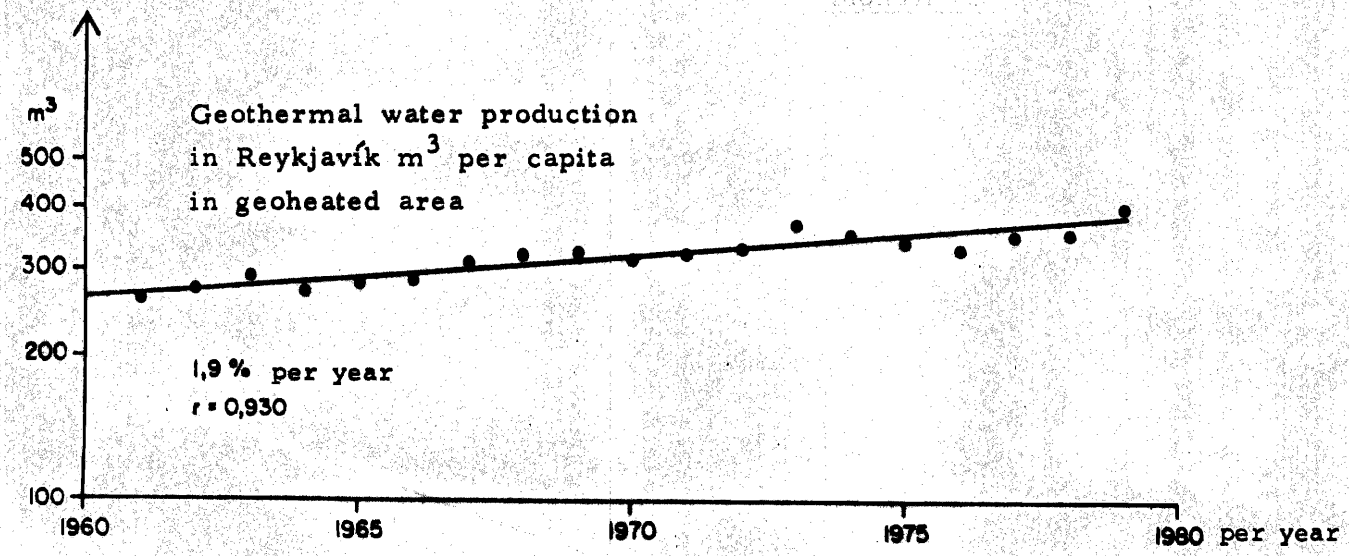
EAST

Population 1980, 12899

Geothermally heated		Electrically heated	
Lagarfell	180 Ih.	Seyðisfjörður	998 Ih.
Egilsstaðir	1133 "	Neskaupstaður	1697 "
		Eskifjörður	1040 "
		Bakkafjörður	70 "
		Vopnafjörður	670 "
		Borgarfjörður eystri	140 "
		Reyðarfjörður	726 "
		Fáskrúðsfjörður	765 "
		Stöðvarfjörður	351 "
		Breiðdalsvík	250 "
		Djúpivogur	397 "
		Höfn	1457 "
N-Múlasýsla			1242 "
S-Múlasýsla			1074 "
A-Skaftafellssýsla			709 "
Geothermally	1313 Ih.	Electrically	11586 Ih.

90% inhabitants in East live in electrically heated areas, but some electrical heating is supposed to remain in Egilsstadir, and it is estimated that 91 % will use electricity in the future.

Table 5.3 Number of inhabitants per apartment in Reykjavik and consumption of geothermal water per capita



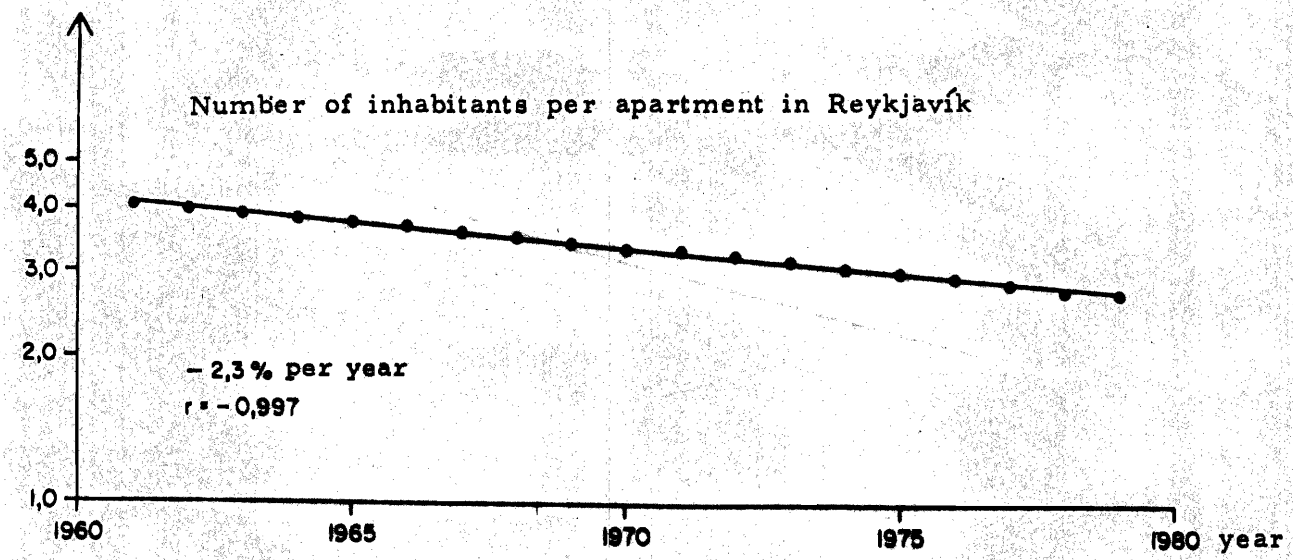


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Table 5.4 Electricity consumption per capita in household